INDEX TO ADVERTISERS AND CONTENTS, PAGE 46.

THE FOUNDRY

Vol. 23. *CLEVELAND, OHIO, SEPTEMBER, 1903.* *No. 133*

PUBLISHED MONTHLY BY
THE IRON AND STEEL PRESS CO.
ROSE BLDG., CLEVELAND, OHIO.

G. H. GARDNER, PRESIDENT AND TREASURER.
JOHN A. PENTON, VICE-PRESIDENT.
A. I. FINDLEY, SECRETARY.

JOHN A. PENTON. - - - - - - - Editor.

CHICAGO: 1115 Monadnock Blk., GEO. H. GRIFFITHS.
PITTSBURG: 429 Park Bldg., A. O. BACKERT.
NEW YORK: 150 Nassau St., D. C. WARREN.
THE CENTRAL WEST: R. A. EVANS.

The subscription price of THE FOUNDRY is $1.00 a year to points in the United States, Canada and Mexico. To Great Britain: Eight Shillings.

Practical articles pertaining to the trade in all its branches are solicited and will be paid for.

We can begin subscriptions with the current number only.

Entered as second-class matter at the Post-Office at Cleveland, Ohio.

Trade Outlook.

The intimation in this column one month ago of a slackening in the pace of foundry operations in some directions has been confirmed by later developments. Just how far general business will contract as a result of several features that have appeared in recent months—strikes, the cumulative effect of high prices, losses in Wall Street (many of them actual losses and not paper losses), and the evident, though as yet not marked, tightening in money—it is yet too early to say. The momentum of prosperity is great, and if the cotton and corn crops turn out as well as some predictions would have them, new activity in the buying of iron is to be looked for between Sept. 15 and Oct. 1. In the month of August there has been some large buying of pig iron chiefly in the Chicago district. Malleable foundries have taken about 100,000 tons of malleable Bessemer, it is reported, and the International Harvester Co. has taken large amounts of malleable Bessemer and of foundry grades, principally No. 2. Its purchases are reported to be from 80,000 to 100,000 tons, about three-fourths of it being Northern grades.

On Aug. 17 the associated Southern furnaces reduced their price from $13.50 Birmingham to $12 Birmingham for No. 2 foundry iron. It is stated that on good sized lots as low as $11.75 has been quoted, and association furnaces are now meeting this. General foundry buying has been heavier in the past two weeks than in any equal time in months. Northern irons are now sold at from $15.75 to $16 at furnaces for No. 2. Several foundry wage disputes have been settled in August, notably at Philadelphia and in the Youngstown, O., district. Additional ground has been gained by the union molders in their campaign for a nine-hour day, this being granted by the Philadelphia settlement. Founders on their part have successfully resisted in a number of cases demands for increase in the minimum wage rate and in others have granted a part of the advance asked in the minimum, while refusing the horizontal advance asked in wages of molders getting more than the minimum.

The Irrepressible Problem.

The man or set of men who are able to read the signs of the times, foresee events and appreciate a coming or present change in conditions are the ones who, other things being equal, are the most likely to succeed.

There has been, there is now and there is likely to be for a long time in this country considerable discussion over the growth, influence and logical results of the Trades-Union movement.

Those employers of labor who have been the most affected have been in many cases the ones who have appreciated the least the change, be it temporary or permanent, in the situation confronting them. The result in such cases has generally been disastrous in direct proportion to this backwardness on the employer's part.

Where the employer, whether a foundryman or not, has realized to the right extent the trend of the times and has understood the exact situation, he has been better equipped to meet the emergency and arrive at a more equitable result than if his position has been one of stolid, bitter antagonism.

The somewhat hysterical opposition shown

so frequently when the labor organization begins to exert an influence has only served to strengthen the agitator and local leader and is most likely to develop into a disagreeable crisis that could frequently be avoided if a different policy were pursued.

The vast upheaval in labor circles through which the country has been passing has been very largely the outgrowth of the business situation, which for a brief period has kept the industrial machinery speeded to the limit of its capacity.

This growth has had many elements of a boom, and the very radical character of the efforts put forth in many directions by organized labor led by unreasoning or ignorant men will have but one result, viz., the more rapid disintegration of those forces which have demonstrated their unreasonableness, their unfairness and unwillingness to appreciate the rights of the other side.

There are certain natural laws regulating trade and commerce in all its branches, which, while they may be deflected and swerved from their natural course by an abnormal demand, by artificial restrictions and limitations, yet in the very nature of things very largely work their own end.

One of the natural influences, and it is a natural and not an artificial one in any way, must be through the medium of organization, whether it is upon the part of employer or employe. And in this respect the employes' interests will be served in proportion to the extent to which in their organized capacity they act faithfully, honestly and conservatively, giving due recognition to the rights of their employer.

The employer on the other hand will only succeed by the same means and by following the same policy, and if either occupies an uncompromising attitude, trouble results and the result is of course the "strike."

In this country the employes are today better organized and better disciplined than their employers.

The employe, the trades-unionist, the labor leader, have a larger fund of general information on the subjects affecting the relative position of the parties interested than the average employer. The result of this is apparent.

Employers have for too long willfully closed their eyes to the situation as it has been, is and probably will be, and they only must pay any penalty arising. If it is satisfactory to them, no comments of any kind are in order.

In this connection, as illustrating the growth of the labor movement in general and in the foundry trade in particular, it may not be amiss to quote from the last issue of the Journal of The Iron Molders' Union a statement indicating the character of its growth during the past seven and one-half years.

This is as follows:

TABLE SHOWING INCREASE.

January	1896	20,920
"	1897	23,003
"	1898	25,072
"	1899	28,941
"	1900	41,189
"	1901	48,115
"	1902	54,251
"	1903	64,472
June 30th,	1903	76,416

This, it must be remembered, is not a matter of conjecture or guess, but is based upon and estimated from the receipts of the organization.

It must be plain to the average reader that an organization with a membership of over 75,000, or about three-quarters, if not more, of the molders of the country is one that can hardly be left out of the reckoning or refused a certain measure of recognition.

When it is remembered that each one of these pays into his union at least twenty-five cents a week or over a dollar per month, it is apparent that here is a movement that to say the least has possibilities.

No one will contend that this ratio of increase is going to be maintained and it is possible in view of the certain falling off of the volume of business that there may be no further increase, or there may be a slight decrease, but it is not going to be at this time sufficient to affect materially the organization itself and perhaps not as great a proportion as the reduction in volume of the foundry business.

To pass from the consideration of that subject for one moment, it may not be amiss to note, as showing that molders' organizations are growing elsewhere, that the Associated Iron Molders, of Scotland, reported on August first, a total membership of 7,232 and cash on hand amounting to upwards of $385,390, while the Friendly Society of Iron Founders', of England, Ireland, and Wales, report for June 20th, 18,407 members and $512,810. Thus, the former have $53.27 per member and the latter $27.85 per member.

There is much in the foregoing that foundrymen and molders alike can ponder over with profit, if viewed in the proper spirit.

But on the other hand, it must be remem-

bered that there is a growing disposition upon the part of employers to resist as unfair and unjust many tenets of trade unionism, some forming a part of their organic law, the balance being in the form of generally understood trade union doctrines.

No permanent peace on equitable lines can ever be attained until the labor organizations are willing to forego some of those methods which have proven most objectionable to employers, and until employers by concerted action become better acquainted with the motives that frequently prompt the trade unionist and prove to him his error. Such a course would remove that feeling of doubt and mistrust that may be said to be universal where employes are kept at a distance by those who should know them best.

Foundry Backwardness.

Startling as the statement may seem, it is yet a fact impossible of contradiction, that considering the character of the work and the capital invested, there is no industrial plant, even in this day of awakening development, in which so little attention is paid to details that tend to economical production as the foundry.

And when we remember that only ten years ago, there were hardly twenty-five up-to-date, modern foundries in existence in the United States—"modern" as the word was understood at that time—the indifference and blindness of foundry proprietors can be the better appreciated.

It is true, of course, that in this period some remarkable progress has been made and now there are scores and scores of first class shops especially fitted for their own particular requirements. But in proportion to the extent to which time and money have been spent in studying the details of proposed improvements generally and the changes that could profitably be made the foundry continues to be neglected to a greater extent than any other department of iron and steel manufacture.

We not infrequently see a foundry and machine shop operated by the same company where more money is spent on one or two machines in the machine shop than upon the entire foundry outfit.

While there is always more or less of a disposition to avoid expenditures for improvements, there is a tendency to ignore the foundry always, which while to a certain extent unaccountable, can yet be partially understood.

In the machine shop, for instance, the operator is more helpless as a general rule without certain tools and appliances to accomplish any great result than in the foundry.

In the latter the outcome depends almost solely upon the skill of the individual, hampered by the lack of proper appliances, while in the machine shop the product is principally that of the tool, a machine simply guided along well defined lines.

It is true that in the foundry the product is more crude, and in a more unfinished state, but is also true that owing to lack of materials or appliances the result is more likely to be disastrous, than in departments where the machine is utilized, and it has come to be pretty generally understood that just in direct proportion to the extent to which the foundry is equipped with the best is the cost reduced.

While there is on every hand plenty of evidence of a rapidly awakening sentiment in this direction; it is yet only too apparent that the number of establishments which operate without giving any attention to even elementary details is disastrously large.

A good deal of money has been made in the foundry business in this country, but it has been made chiefly by the specialist who made one line of work or made a close study of every possible factor applying to the product of his specialty, or by the general foundryman, who without being extravagant, was always on the anxious lookout for a chance to invest one dollar, ten, a hundred or a thousand, when he felt the investment would help him to double his money.

The day, however, is very rapidly coming when only those who have inaugurated the most modern methods and systems in every department are going to be able to stay in the race.

The best sand, molding machine, molder, cupola, iron, and fuel, for the purpose, the best foreman at any reasonable price, and lastly the best system for economically welding all together and speeding them to the fullest capacity, are the only ones that in the long run are going to pay.

Foundry Cost-Keeping.

From time to time THE FOUNDRY has presented suggestive articles on cost keeping and allied matters. These have been as a rule taken from the practice of foundries. They have not been in any sense experiments or mere speculative efforts on the part of the writers. Undoubtedly there is a great field for work in this connection. System is as applicable to foundry practice as it is to any

other business and the results of such expert management have been its best endorsement.

The importance of the subject is not to be measured by the amount paid for the clerks who have the work in hand but must be based upon the advantage of the system as a money making device. A cost keeping system has no claim to consideration unless it saves money in exactly the same sense that a crane economizes, or a molding machine. About the time that a good crane is installed or the twentieth molder is hired is a good chance to look over the cost keeping system or its substitute.

Many managers experiment and finally cast a method aside because of some peculiarity which makes it seem too costly. The better plan is to stick to a system which has been tried by some known firm and has stood the test. There are managers who freely explain their methods on the ground that even competitors should know casting costs with accuracy, and thus save much of the guessing which inspires under-bidding.

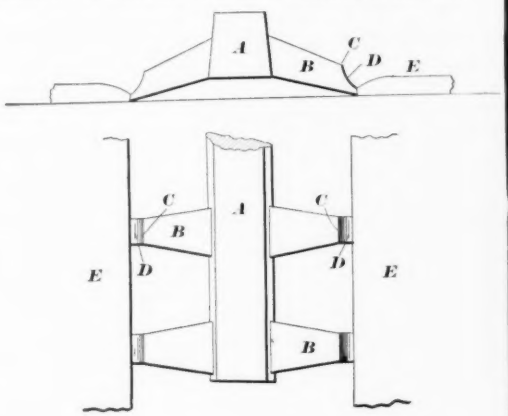
Expert knowledge is a good thing to have on this work. The service of an accountant who has made a study of manufacturing systems is quite worth while. Be sure of your man. There are plants which have enlisted such assistance to advantage and there are other plants where the advantages are not so manifest. The system must be simple or it will be shirked by everyone and will be a bone of contention between proprietor, bookkeeper, foreman and molders. It must be complete so that all the elements that go to the making of a casting shall be enumerated in a close cost of labor and material. There must be exact discrimination as far as this is attainable between time taken for molding and pouring, for superintendence, for crane operation, for laborers, coremakers, etc. There should be such a general account that the casting costs can be ascertained from the pig iron to the load ready for shipment from the yard. Less than this is of little worth and more is of very doubtful utility. A circulation of such systems as have stood the test of use is beneficial to the trade, and THE FOUNDRY hopes to continue to receive the details of methods whose efficiency has been proved.

The Central Brass Works Co., of Kansas City, Mo., has been incorporated with a capital of $50,000 by Adolph A. Dora and W. P. Prier.

A Pattern Proposition.

Gate patterns must be large enough for the free flow of the molten metal to the mold and at the juncture with the pattern proper must be thin in order that the surplus metal may be easily broken off the casting with as little injury as possible. How large the one or how thin the other is not now so important but in practice the two influences account for a sharp change in contour where the one part of the pattern runs into the other. A simple method of forming this connection is submitted in the patent granted Fred H. Arnold, of Reading, Pa.

The engraving shows an end view and a plan of a pattern gate for which much is claimed in the way of screening dross and dirt from the molten metal. The main gate pattern is seen at A and this part of the pattern may be at any desired shape and has a number of feeders B which extend from the



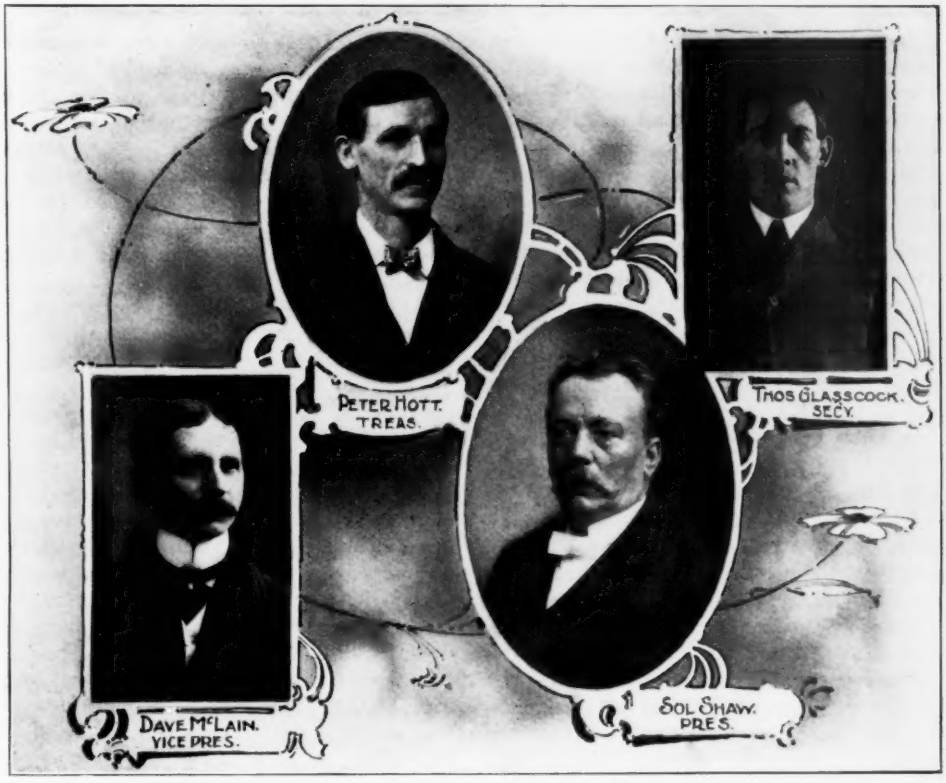
sides of the main gate pattern above the base. These feeders B are formed at a slight downward angle from the point of connection to the main portion A with the intention of insuring a free flow of the metal down the inclined portions to all parts of the mold. The feeders B are tapered toward their outer ends and the outer corner of the upper face of each pattern is removed to form a shoulder C. The end is curved from this shoulder as shown at D, in an oblique direction toward the lower and outer extremity making a reduced section on joining the main pattern at E. The corner C checks the flow of the upper portion of the stream of metal and catches the dross and the curved end D "will insure the easy flow of the metal which being cleaned of all dross and foreign substance is practically a pure metal and will not only flow freely but will pass from the gates in a fine stream and thus

permit a much thinner casting than would otherwise be possible." The inventor suggests that the plan is capable of ready application; a little wax, solder or wood affixed at the critical point is all that is essential. The metal chokes at C and D and the dirt will rise and hug the shoulder C while the clean metal is hustled into the mold. All of which is very desirable "as described."

Milwaukee Foundry Foremen's Association.

At the time the American Foundrymen's Association held their last annual convention in Milwaukee in June of the present year, a number of the local foundry foremen, appreciating the importance and value of the organization movement, decided to form a local association to be composed of a superintendent and manager of the various iron, brass and steel foundries of that vicinity. The effort made by them in this direction has been successful to an extent that those who were instrumental in forming it but little anticipated, as a result they have succeeded in securing as members the bulk of those who have charge of the twenty-eight iron foundries and four steel foundries located there, and in addition have secured applications from a number occupying responsible positions in connection with several of the brass foundry concerns of the Cream City.

Meetings are held at regular intervals, and every effort made to bring out in the discussions that arise, the thought and experience of those present concerning the large number of complex problems constantly coming to a surface in every foundry, be it large or small. The local Metal Trades Association has kindly donated the use of its rooms and meetings are held on the first and fourth Mondays of each month.



The president of the association is Mr. Sol Shaw who has charge of what is known as the "South Shop" of the Allis-Chalmers Co., and is one of the best known foundry foremen in Milwaukee and the West. Mr. Shaw has the reputation of having at various times devised original methods for the construction of many of the exceedingly complicated castings that had been made in his own establishment and which have been quite generally copied by foundrymen in other sections.

Mr. David McLain who is vice president of the association, is superintendent of the National Electric Co.'s iron, steel and brass foundry, and came originally from Pittsburg. Some great claims are made by Mr. McLain's friends as to his ability and experience in the steel branch of the foundry business especially.

Mr. Peter Hott is treasurer of the association and is likewise one of the best own foundry foremen in Milwaukee with an excellent reputation in the trade. He has charge of Bayley's foundry and anyone familiar with the character of work made there can readily appreciate anything that his admirers say of him.

The very efficient secretary of the association—and he has had much to do with its success—is Mr. Thomas Glasscock who has charge of the foundry of Pawling & Harnischfeger.

In these days of foundrymen's organizations of every description, this latest association is especially welcome. The precedent established by the foundry foremen and superintendents in Milwaukee is commended to the serious consideration of those occupying similar positions in other sections of the country.

The Ideal Foreman.

PAUL R. RAMP.

The foundry superintendent or foreman should be a practical molder, one who has pounded sand himself. He should be to a certain extent a draftsman. He must be able to direct the iron mixtures and the managing of the cupolas, in fact he must be familiar with all the details in foundry work including molding machines, cores, etc.

However one of the most important requisites is that he should be of human nature. Nothing is more essential to his success and the success of his employers than his ability to make the men under him feel that he takes a personal interest in them, and that he is placed in his position for the purpose of helping them.

Some men are natural born managers and possess a certain magnetism that draws men to them. Such men can accomplish more than the less fortunate.

After accepting a position as superintendent or foreman of a shop one must curb that inclination or desire that is born in nearly every mechanic and manager to begin at once to revolutionize the entire shop and methods of working. The first step should be to get acquainted with the men and the local conditions. While the new man is thus engaged and to all outward appearances doing nothing else, the spirit of distrust among the men which is generally created when a new man takes charge is gradually subsiding and by the time he is ready to make the first move towards bettering conditions he has to a certain extent gained the confidence of the majority of his men.

In making changes in a strange shop it is always policy to take up the smaller things first and things that do not conflict to any great extent with the usual routine of work in the shop.

Let the change or improvement be something that will exhibit true mechanical ability as nothing will help a foreman to gain the respect of his men quicker than to demonstrate by little changes on different jobs and methods of working that he thoroughly understands his business. There is a certain class of men that will admire him for his knowledge and a certain class that will fear him, these things are necessary to his success.

I consider it advisable for a foreman to go among his men and talk to them about their work and other men's work in the shop. In carrying on a conversation of this kind one must make his man feel that his opinion is valued because every man has a certain amount of pride and no matter what his work may be when he is made to feel that he is considered more than a mere machine he will begin to examine himself and to use every effort to become worthy of the opinion of his foreman or superintendent. While he is working with this object in view he is becoming more proficient in his trade.

The writer at one time had the pleasure of working for a manager as foundry foreman who would not keep a man in charge in any of the different departments who did not spend the most of his time among his men out in the shop. I remember going through one department of the works with him one day and in speaking of the foreman in charge he said: "I am afraid I will have to make a change here. This man is always in his office and I seldom see him among his men." Although my policy had always been to keep in close touch with my men it is needless to say I continued the practice more than ever.

It is very essential for every foreman to know his men, not simply their names and the job they work on, but their dispositions as it is not an easy matter to satisfactorily settle

any grievance with a body of men who are nearly strangers to you. But if you kept in close touch with them and know them personally you can refer different points of the argument to John or Charlie asking their opinion and nearly knowing what their answer will be.

We all agree, I am sure, that when a foreman is compelled to listen to the grievances of labor organizations the shop is not in the condition it should be; but as this is generally the result of previous management, those in charge are obliged to resort to all manner of diplomacy to acquire the end in view.

Some will say that in a shop working 500 or 600 men it is not easy to know them all. To a certain extent this is a mistake as in a shop of this size one should have sufficient help to enable him to look after his men properly. While he may not be able to reach every one of them, he can keep close to many and if your dealings are honest and straightforward they will all know you.

Some men must be driven but the majority led. There is I believe a natural instinct that enables us to distinguish one from the other. I believe nine men out of every ten are willing to do right, and if we do not give them the opportunity to prove that we are anything but just and fair in our dealings with them we make it impossible for the few howlers that can be found in every shop to verify their many radical statements concerning the company or the superintendent. It is these howlers as I shall name them that do much towards causing discontent among men, and as it is not always policy to get rid of them and sometimes impossible we must do all we can to counteract the harm they do.

To successfully carry on the foundry business or any other business today where a large body of men are employed it is very desirable to have the men with you; at any rate, to have their confidence. It is not necessary to become too familiar with any of them, in fact a foreman never should, in any way loose his dignity, neither is it best to at any time make a man feel that you consider yourself his superior even if you should have such an opinion.

Some foremen have strange ideas about maintaining their dignity as they call it. I have known several who would not under any circumstances carry a pattern or core-box to any part of the shop, use a skimmer or do anything that resembled real work, or dirty their hands for fear of appearing undignified in the eyes of their men. I do not consider men with such ideas very valuable as foundry foremen.

It is of course supposed that a foreman is paid for his knowledge of the business and for the amount of work he can get others to accomplish, and not what work he can do himself. However, I believe a foreman hurts himself when he does not occasionally take a hand in the work.

One will not lose any of his men's respect for him if he stops on his way through the shop to aid in setting a core, closing a flask, or ramming up a cope for an apprentice boy. In fact, it is a good thing sometimes to show the boys that the old man has not forgotten how.

I do not consider it essential to the out put or success of a foundry for a man to go about the shop with a scowl on his face and an oath on his lips. Even the most depraved creatures respect a clean man. While I would not recommend that a prayer meeting be held in the shop, I consider it necessary that the foreman be a gentleman. A superintendent or foreman should always be ready to lay down his work and listen to any suggestion from any of his men or to any of his troubles. If one of them should have a sick wife or child at home, inquire about them. This will cost nothing and may do a great deal of good.

Always speak to your men on the street and in the morning upon arriving at the shop. I have found the soft spot in many a rough fellows nature through these channels. Little things, though they are, they make men like you. The key to the successful handling of men is courteous treatment and honest living.

When a man has by his every day life and his personal interest in those under him caused men to respect him, he can accomplish that which the man with the club never will.

Another item of great importance is to hold your temper. The man that is hot-headed will make many blunders and it must be remembered that when your man causes you to lose control of your temper he has in a certain sense got the best of you. An uncontrollable temper is a weakness that will hinder the progress of any man no matter what his ability may be. An ill-tempered foreman or superintendent sometimes uses a great deal of sarcasm. This causes men to dislike him more than if he was loud and harsh, as it is difficult for them to always understand sarcastic remarks. They only know that something has been said that arouses an ugly feeling in

them and that they have not been able to defend themselves.

The man who has been in charge of a shop all his life where he has been able to stand over his men with a club will hardly appreciate the above methods. However I believe under all conditions the one necessary in handling men is to treat them as men.

Making a Pulley Without an Anchor.

The making of a pulley without an anchor from a ring pattern and loose arms has been joked about among molders frequently and while not regarded as being much of a problem has sometimes caused discussion. H. M. Bury in a letter to THE FOUNDRY has this to say on the subject:

There are very few jobbing foundries throughout the country, that have not had an experience somewhat similar to the following About two hours previous to blast-time an order will be handed to the foreman for a small pulley, all the way from 14 inches to 20 inches diameter; and written on the order in red ink the following: "Cast today sure." The first thing done is to search for the anchor; which is either broken beyond repair, or cannot be found. The only course left is to make the pulley without anchor; which is done in the following manner. First secure a three-parted flask with two copes, with cheek same depth as face of pulley wanted. Lay the rim pattern on follow-board in an inverted position; namely with draw holes down. Now ram up the cheek. Bed the arms in centre and make parting in the usual manner. Next put on the cope, and gagger the inside of pulley over the arms securely, so as to insure a "good lift," not forgetting to put a pop gate on the hub for pouring. After cope No. 1 is rammed, put on clamps and roll over. The rim is now right side up for drawing. When making parting at this joint, have same of a convex form inside of rim; so that when rolling over the second time, the core will not slide whilst in a horizontal position. Now ram up cope No. 2 and lift off; draw rim and replace cope. Roll again, and lift off cope No. 1, and if care has been taken it will be gratifying to see what a "clean lift" is obtained. All that is now necessary is to draw the arms, and blacken mold. Put on cope, and clamp, and pulley is ready to pour. A pulley of small size can be made in this way, in a surprisingly short time if the molder is careful in rolling back and forth.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and Using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

MELTING RATIO AND MIXTURE.

Question. Our inside cupola diameter is 64 inches. From sand bottom to bottom of tuyere is 12 in. There are 4 rows of 16 tuyeres; diameters 3⅛, 2½, 2⅛ and 1⅞ inches. Combined area 280 and windpipe 314 sq. in. From sand bottom to top of upper tuyere is 27 in. and the coke bed reaches 24 inches higher yet. Charges are: Bed coke 2,400 lbs., iron 5,000 lbs., coke 480 lbs., iron 2,000 lbs. and the same for all other charges of iron. The next two coke charges are 416 and all the rest 320 lbs. We have a Root blower delivering 6,660 cubic feet per minute. The first iron is white hot but before the 5,000 lbs. is melted it is a trifle dull. Melting ratio 4½ to 1. We use 2 parts Stonega and 1 part retort coke. When in Detroit I noticed that you did better melting than this. Can you suggest a way to improve our melting? How do you determine the melting ratio? Do you charge coke by shovelfuls or by actual weight? Is there danger from sulphur if retort coke is used entirely?

Regarding making an iron mixture by fracture: The other day some pigs from a car broke very easily and showed a silvery white color; on some pigs a delicate tracery similar to frost on a window-pane. Is this presumably high silicon iron? Only one of the irons in our mixture is high in graphite. Our castings (stove plate) are very soft but seem to be brittle, judging from our breakage in our cleaning mills, which is about 1.80 per cent. What should this percentage be? How can we toughen our iron?

Answer.—I prefer one row of tuyeres about 4 inches high and as nearly continuous as possible. This would save 7 inches or 400 lbs. of the above bed coke and would concentrate the heat low down and prevent any cold air being blown over the coke charge. The charge of iron on the bed is too large as shown by the dullness. It is better to make each charge of iron the same and I prefer 3,000 lbs. rather than one ton. Generally the coke for the second charge can be made 200 lbs. and 260 lbs. is enough afterwards.

If the iron is dull at any point, next day add a little coke at that point. As the coke recovered from the dump has been weighed

it is as well to let the melter have it to use as he pleases and where needed. These charges will give a ratio of about 9 to 1 if over 30 tons are melted.

Break scrap very small and charge very evenly and close. Keep dirt out of the cupola. In trying to better your condition subtract no more than 10 lbs. of coke from each charge or else add 50 lbs. of iron to each charge and then run a few days to gain confidence. Don't try two things at once and go slow with changes.

To determine ratio divide all iron charged by all new coke charged. You cannot weigh coke taken from the dump as it is mixed with iron and slag and is water soaked. The recovered iron is weighed as remelt.

Do not measure or guess at anything put into a cupola except limestone. Weigh everything correctly.

Retort coke made from the same coal as beehive coke will contain the same sulphur. I use the same blast and quantity which ever coke I use. The maker of retort coke can give you uniform quality if you demand it.

Probably the iron you describe was really a silvery iron.

You are guessing entirely about your silicon. How is it that you are so positive that only one of your irons is high in graphite? If your castings are soft the graphite and silicon are both high. This is an example of the way most foundries are run, all by guess work and then wonder at losses and breakage.

The only way to run a foundry and make money is to know what you are doing. Either spend money to have analyses made of every car of iron and calculate how much of each kind to use to have about 3.00 per cent silicon for stove plate, and then have your plate analyzed at least once a week to see if you are getting what you expect. Or else:

Use mechanical analysis and measure the shrinkage of a ½ inch square test bar. If it is between .125 and .135 you have about 3.00 per cent silicon.

I presume that you will find your shrinkage below .120. If so, reduce your silicon by leaving out some of the iron that had the silvery fracture. By changing one and then another iron and watching the shrinkage you will soon learn which pig irons increase and which decrease shrinkage. When you learn this much you need never have any trouble that you cannot get out of.

As strength can be varied independently of the chemical composition it is better to break a couple of test bars each day. You can toughen iron by varying your mixture but do it so as not to vary shrinkage. The only way to find out which mixture is strongest is by a test.

The average percentage of our mill breakage for the past six months is ¼ of one per cent. Yours is seven times as much. Breakage in the mill need not show weak iron, but careless packing and handling. Mounters' breakage is often due to carelessness.

If you know by a test that a ½ inch square test bar will break at over 380 lbs. you can insist that breakage be reduced. Don't guess at anything in foundry work.

How They Do It in Manchester.

BY JOHN SWAIN.

There is no doubt that an experienced man who is a good manager around the cupola furnace is the one who holds the key to the situation and that his place should be in the stock yard, as well as on the charging floor.

We are melting 50 tons a day with three laborers, one metal mixer or charger and a young man acting in the capacity of weigher or record clerk.

Our stock yard is laid out with light railways for a gauge of 2 ft. 6 inch., running past the different brands of pig iron and also leading directly to the stock of scrap and coke. The railway tracks terminate just before reaching the weighing machine, which has a smooth top and is located at the foot of the hoist. The hoist may be worked by the laborer who charges the metal into the furnace.

The stage or charging platform is covered with plain plates and slightly inclined from the hoist to the mouth of the furnace, so that the trucks loaded with metal may be moved with less exertion on the part of the laborer. The mouth of the furnace of cupola is arranged at the correct height and has a ledge or lip attached to it, so that the mouth of the truck, when released by the cotter, drops on to it and empties its contents.

The metal trucks are made strong and durable, although not too heavy. The charging boxes used in connection with these furnaces are made from 5-16 or ⅜ plates built up on frames. The box itself has three sides and a capacity of 8 cwt. mixed iron, and is operated through journals so that when the furnace is reached it may be tipped, when the laborer releases a pin.

Coke is a material which forms a rather expensive item to the iron founder in many

ways, and therefore it should have every consideration. Should the changes of coke be in any way irregular, the melting and temperature of the iron is likewise. If the laborer uses too much fuel, this is simply burned away and impedes rapid melting. On the other hand if too little fuel is charged, the cost of the castings are increased on account of lost castings through dull iron. Our practice today is to send complete charges of iron and fuel to the charging platform by way of the hoist, the iron loaded in charging boxes, as previously described, and the coke weighed up in baskets.

We find that these baskets are economical to use for the reason that they hold a given quantity of coke, 28 pounds, two of which are enough to melt one charge of iron after the cupola is provided with its bed of coke, assuming that this is a fair quality. These baskets are easily handled, both in the stock yard and at the cupola or charging door, hence they do away with the use of the shovel which is somewhat of a help to the laborer on the charging platform.

The above description will no doubt give the reader sufficient idea as to our method of handling material. A few words about the way our laborers are employed around the stock yard and cupola may not be amiss. When the whistle blows the metal mixer receives his orders from the foreman as to what mixtures the latter desires for the day. While he is doing so, the laborers are charging the cupola with coke which is being recorded on a daily sheet for the purpose of later obtaining a correct cost account. The metal mixer having by this time received his orders runs separate wagons to each brand of pig iron which is to be used and when these are filled they are run down on one side of the weighing machine while other laborers are filling trucks with scrap stock, which is also run down to the machine. When these are at hand the metal mixer weighs out the different brands of iron and scrap necessary to complete each charge as well as the two baskets of coke, all of these being recorded separately by the weighing clerk on the daily charging sheet provided for this purpose. The truck now contains a complete charge and is run off the weighing machine onto the hoist, from which it is run onto the charging stage, and an empty truck returned to the stock yard. The laborer in charging the cupola first empties the two baskets of coke and then distributes the pig iron so that this will be as even as possible. He then knocks out the pin which holds the charging box in place on the truck, when all the scrap and material is emptied directly into the cupola. This saves considerable labor as a good deal of time is generally consumed in handling small pieces of scrap. Limestone is really only a minor thing in cupola work, although it bears a very important relation in regard to the clean work of the furnace.

Manchester, England.

News Notes.

Under the name of Ensley & Miller, J. E. Ensley and Matt Miller, of Auburn, Ind., will establish a foundry and machine shop. The building as planned will consist of a main part 30x72 feet, with a wing 24x42 feet, one story high. In addition to doing custom work they anticipate the manufacture of certain articles.

The Interstate Drainage & Investment Co., of Britt, Ia., has purchased the foundry and machine shop business of the Garfield-Richardson Co., Algona, Iowa. The intention is to move the plant to Britt, but for the present and until suitable shops can be built, the business will be continued at Algona. This gives the Interstate Drainage & Investment Co. facilities for repairing its ditching and other machinery and in addition the shops will be used for jobbing and general repair work.

The Bessemer Foundry Co., Grove City, Pa., is building an addition to its present foundry 100x110 feet, including new core ovens, elevator and cranes. It is also adding a steel structural building, 53x275 feet, to its erecting and testing department.

The Larimore Rotary Engine Co., of Modesto, Ill., has been incorporated with a capital stock of $10,000. It is intended to erect a complete manufacturing plant, including a foundry. The company is composed of J. W. Larimore, W. K. Mertz and T. B. Wright.

Wolfe & Englert, proprietors of the Composite Metal Co., Catasauqua, Pa., have broken ground for the erection of a new plant. A brick and steel foundry, 60x150 feet, and other buildings are to be erected. The melting department is to consist of ten crucible furnaces, an 8-ton reverberatory and a 15-ton open-hearth furnace, an oil furnace and a cupola. Electric cranes and other modern foundry equipment will also be installed. General gray iron castings, as well as the manufacture of brass, bronze and other composite metals, will be the product of the new plant.

H. G. Shellenberger & Co., of Philadelphia, proprietors of the Union Foundry & Machine Co, at Catasauqua, Pa., have purchased the Weaver-Hirsh Foundry & Machine Works at Allentown, Pa., and will put them in operation at once.

The Denver Steel Casting Co., of Denver, Colo., has been incorporated by Chas. L. Buckingham and Augustus H. Phillips, with a capital of $500,000.

The Waterous Engine Works Co., of St. Paul, Minn., will replace its foundry, recently burned, with a structure 75x200 feet.

The Aurora Foundry & Machine Works, with plants at Iola, Kan., and Aurora, Mo., the Crescent Iron Works, and the Sterling Iron Works, both of Springfield, Mo., have consolidated their interests under the name of the United Iron Works Co., with a capital of $650,000.

The American Frog Mfg. Co., lately incorporated with a capital of $250,000, has purchased the plants of the Cookson Mfg. Co. and the Kansas City Switch & Frog Works, and will operate same, erecting complete switch and frog plant, foundry and machine shops.

John Thompson will reopen the foundry at Rock Island, Ill., which for many years was operated by his father, the late W. H. Thompson.

The Shunk Plow Co., of Bucyrus, O., has outgrown its old quarters and is building a new foundry 60x200 feet. All kinds of light gray iron castings will be turned out.

It is reported that the C. C. C. & St. L. Ry. (Big Four) will soon commence the erection of a large iron foundry to be operated in connection with its shops at Urbana, Ill. Since these were built, years ago, the foundry work has always been let by contract to private concerns, but it is believed the work can now be done more cheaply at the company's shops.

The Howe Mfg. Co., of Louisville, Ky., maker of brass goods, has incorporated with a capital of $500,000.

The Lima Locomotive & Machine Co., of Lima, O., has increased its capital stock to $600,000.

The foundry of the Caldwell Foundry Co., Fort Payne, Ala., which has been idle for some time will shortly be placed in operation. It was recently purchased by a number of gentlemen who have organized the Valley Foundry Co. to operate the plant.

The Bollmann-Wilson Foundry Co., Cincinnati, has abandoned its plan for doubling the size of its plant at Norwood.

The Howard Iron Works, Buffalo, N. Y., are adding a large foundry to their plant.

The D. E. Whiton Machine Co., New London, Conn., has nearly completed its new foundry, which is 35x60 feet, with an L 35x85 feet. This foundry is a part of the extensive enlargements recently made to the plant.

A large foundry will soon be erected by the Crucible Steel Casting Co., of Milwaukee, Wis. The building will be of brick, concrete frame, and hollow tile construction, and will measure 70x173 feet. It will cost $9,000.

Sawdust for Drying Out.

After metals have been dipped, pickled, or plated, they are rinsed in water to remove the solution that may adhere to them. The surface after rinsing is, of course, moist and if left to dry spontaneously the surface becomes discolored. To obviate this, it has been customary, even in the earliest days of the industry, to dry the article in sawdust; usually cold, but conducive to much better results if heated.

Simple operation that it is, it is surprising to find many using the cheapest grades of sawdust for this purpose and then wondering why the lacquer does not adhere or spots form on the surface. Upon first thought, one might naturally think that one kind of sawdust would be as good as another, but it is not so. A satisfactory sawdust must be dry and capable of absorbing as much water as possible and for this reason there is probably nothing worse than that obtained from the town sawmill. Full of yellow pine, it not only fails to do the work, but actually leaves pitch on the surface of the work to be dried. This kind of sawdust should be wholly avoided. White pine, spruce, or hemlock sawdust while superior to the yellow or pitch pine leaves much to be desired as it is not very absorbent. Maple of better still the well-known "Royal Hardwood" forms excellent materials and probably more of the latter is sold than any other kind. It has the advantage of not being expensive. Turkey boxwood is largely used by platers and forms an excellent sawdust for their work. It is also the most expensive.—*The Metal Industry.*

CORE OVENS WITH STEEL ROLLING SHUTTERS.

INTERIOR OF FOUNDRY.

SYSTEM OF CURBING EMPLOYED ON LARGE LOAM MOLDS.

ARRANGEMENT FOR CLOSING HEAVY CUPOLA BOTTOM DOORS.

50-FOOT EXTENSION OF CRANEWAYS OVER LOADING TRACKS.

VIEWS OF THE NEW HEAVY WORK FOUNDRY OF THE INTERSTATE FOUNDRY CO., CLEVELAND.

The Interstate Foundry Co.'s New Plant for Heavy Castings.

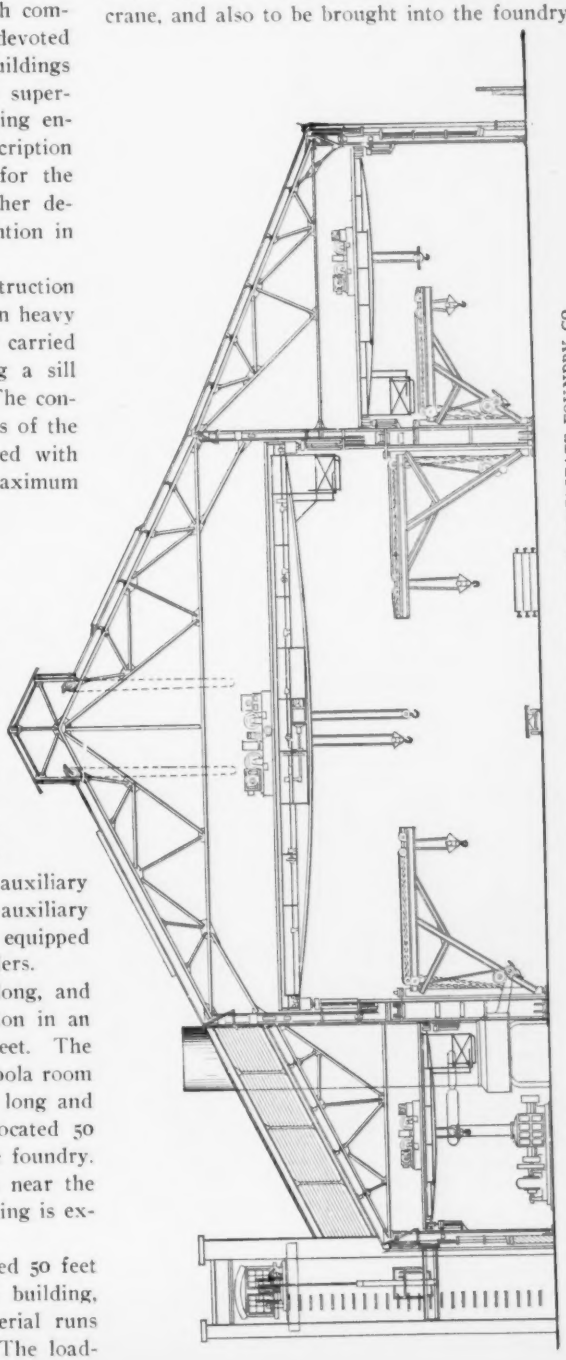
Among foundries of recent construction erected with a view of turning out the heavier class of castings is the new plant of the Interstate Foundry Co., Cleveland, O., which company has also another large foundry devoted to light castings exclusively. The buildings were designed and erected under the supervision of Kaltenbach & Griess, consulting engineers, Cleveland. The present description refers exclusively to the new plant for the manufacture of heavy castings, the other department having already received attention in the columns of THE FOUNDRY.

The building is of steel frame construction with a slate roof, the slate being laid on heavy wooden sheathing. The side walls are carried six feet above the grade line, having a sill line running all around the building. The construction from the sill line to the eaves of the roof is in panels of sliding sash fitted with clear common glass, giving the maximum amount of light and ventilation. All other curtain and end walls, also walls in the elevator tower, are of brick masonry.

The building in the main cross section consists of a main aisle 80 feet wide, lean-to on the south 40 feet wide, and a lean-to on the north 30 feet wide. The height of the crane runway in the main aisle is 32 feet from the foundry grade, and on this runway there is at present in operation one 40-ton and one 25-ton four-motor electric traveling crane. The 40-ton crane is fitted with a 10-ton auxiliary hoist, and the 25-ton with a 5-ton auxiliary hoist. The two lean-tos are each equipped with two five-ton three-motor travelers.

The present building is 300 feet long, and provision is made for future extension in an easterly direction of 300 additional feet. The north lean-to is interrupted by the cupola room and charging floor, which is 50 feet long and 30 feet wide, the east wall being located 50 feet from the present east end of the foundry. This location will bring the cupolas near the center of the building when the building is extended in the future.

The main crane runway is extended 50 feet on the outside at each end of the building, and the loading track for the material runs directly under this crane runway. The loading track has no connection with this supply track, so that there is never any interference or shifting of cars required for castings shipped and material received. The crane runway at the opposite end enables large flasks to be carried outside of the building by means of the crane, and also to be brought into the foundry



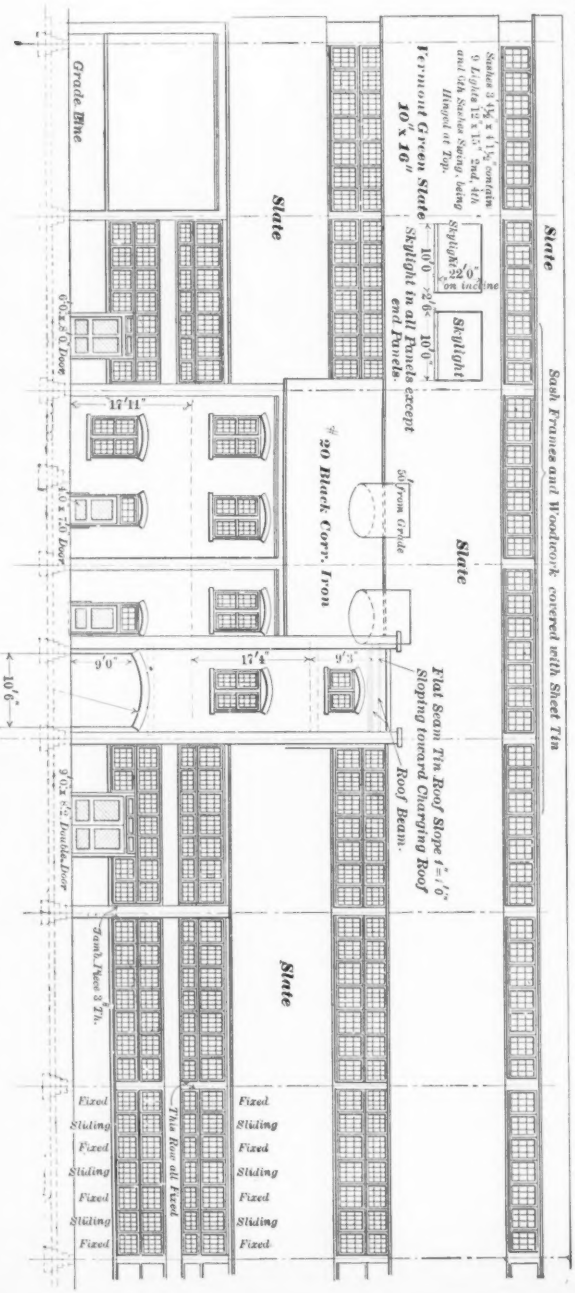
CROSS-SECTION OF THE HEAVY CASTING DEPARTMENT OF THE INTERSTATE FOUNDRY CO.

VIEWS OF THE NEW HEAVY WORK FOUNDRY OF THE INTERSTATE FOUNDRY CO., CLEVELAND.

CORE OVENS WITH STEEL ROLLING SHUTTERS.
ARRANGEMENT FOR CLOSING HEAVY CUPOLA BOTTOM DOORS.

at a minimum cost, on account of the convenience of handling.

There are two cupolas at present in place, and provision is made for two additional cupolas. One of these is 86 inches outside diameter, and the other 104 inches outside diameter. The total height from base to stack is 70 feet. The cupolas are supplied with blast from two positive pressure blowers, direct connected to a 230-volt motor. The drop doors on the cupolas are fitted with special attachments for raising the doors, consisting of forged levers, with sheaves, mounted in the ends and connected with wire rope passing to a hand winch.



ELEVATION OF A PORTION OF THE INTERSTATE FOUNDRY CO.'S HEAVY WORK SHOP SHOWING PRINCIPAL CONSTRUCTION DETAILS.

The elevator is mounted in a tower which can only be entered on the ground floor from the outside. The elevator hoist is fitted with a 35-h. p. 230-volt direct current motor and has a capacity of ten tons and will accommodate two charging buggies. A special feature in connection with this elevator is the fact that the scale for weighing this material is framed directly in the platform and the weights are noted after the load is hoisted and just before the buggies are run on the charging floor. The proposed system for handling this material is to charge directly from buggies to cupola, thereby preventing the rehandling of the material.

The core ovens are located just east of the cupola room in the lean-to, and are fitted with rolling lift doors, and down draft flues.

The top of the core oven forms a storage platform for facing material and other foundry supplies, with a balcony extending into the main aisles so that material can be handled by the cranes in the main aisle.

The building is arranged with a large lift door with steel frame, and covered with sheet metal, which when open permits the cranes to pass in and out of either end of the building on the runways. This lift door is practically balanced by counterweights, and is raised by a cable attached to the crane, which when running along the runway will lift the door and vice versa.

The gables are fitted with fixed sash throughout, and the roof has skylights of liberal dimensions,

fitted with wide-ribbed glass and copper curbs. All valleys are fitted with copper gutters and details throughout are of the best and up-to-date, as required in foundry construction. Special attention has been given throughout to the proper facilities for light and ventilation, which is important to secure the best results in foundry work.

The capacity of the heavy castings plant is steadily increasing, and it will soon reach an output of 125 to 150 tons per day.

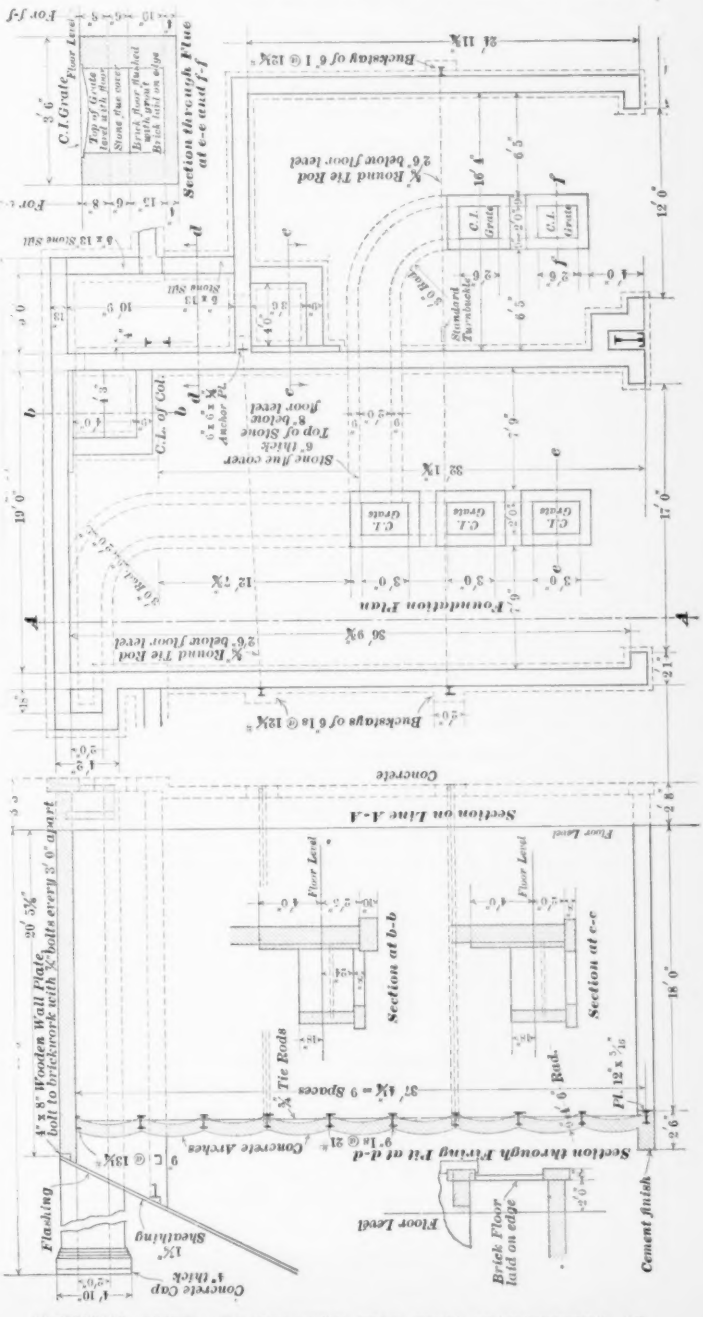
A Promotion.

William A. Perrine, one of the best known molders in New York City, has resigned as business agent of the Iron Molders' Conference Board to take a position with the Cox Stove Co., Philadelphia. He was appointed civil service commissioner shortly after the election of Mayor Low, but resigned some time ago because of the increasing work of the Iron Molders' Board.

Finishing Deep Lifts.

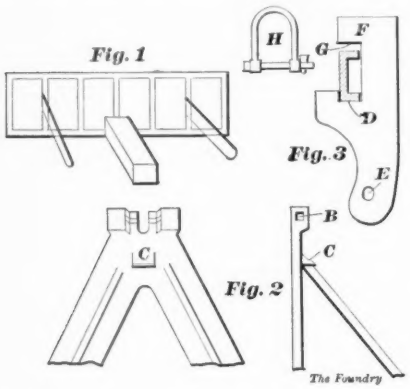
Most molders have at some part of their career experienced the delight of finishing a mold over-head, with its pleasant accompaniment of sand in the eyes, in the sleeves, together with the odor of smoky lamps, and while so engaged, they have doubtless speculated on how much more comfortably they could work if the job was turned over and they could be on top, instead of having the cope on top of them. While I am prepared to admit that finishing a mold over-head may be the speediest and most economical course to follow for a great many plain jobs, yet, I contend that a lot of molds finished in this way would show a saving of 50 per cent in time alone if turned over, not to mention the greater comfort and safety of the workmen; besides the casting would show a better appearance.

Many foundries are deterred from turning large molds over for fear of the lifting equipment giving way at some time, or they do not possess enough head room under the crane;



SECTIONAL VIEWS, ILLUSTRATING CORE OVEN CONSTRUCTION AT INTERSTATE FOUNDRY CO.'S PLANT.

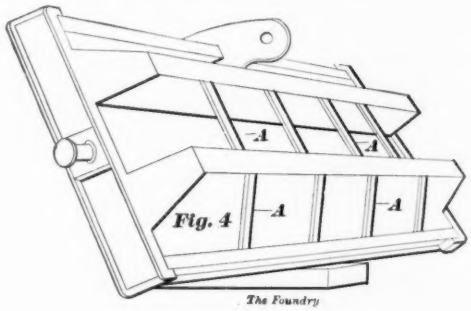
others dislike the risk of the flask being pulled off the trestles, when turned over on centers by the crane. Sometimes there is also a lack of proper tackle to carry the cope past the dead center when turned as above. Where copes carry deep lifts it is the usual custom to stud the lifting grates between the staples, carrying the stud up to the flask bars, where they are tightly wedged down before fastening the grate. This is fairly effective if done intelligently, and the studs so placed that when the flask is turned on edge the stud will be a little below the center line of the lifting staple as shown in Fig. 1. Any other position is useless. An improvement where it can be used is shown at A Fig. 4 where a little sand has been dug from the edge of the lifting grate



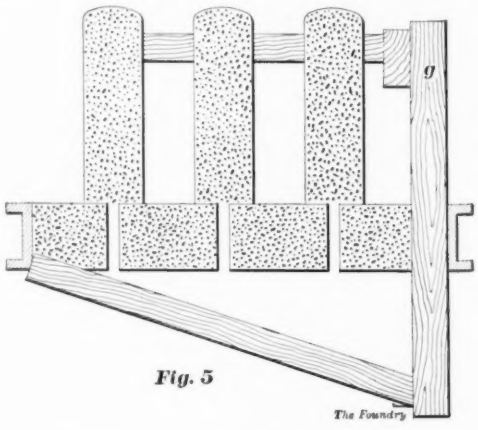
and the props A wedged in which makes an absolutely safe job. What little sand has been disturbed may easily be made up after the cope is turned back for the last time.

Where there is not sufficient head room it is possible to turn a cope with a deep lift over on centers where this could not be done on blocking, as by the former method the edge of the flask may come close to the ground, while the blocks must be high enough to keep the lift clean off the floor when the cope is in a horizontal position. Whatever risk there may be in turning a flask on trestles can be entirely avoided by using properly designed trestles as shown in Fig. 2. These are provided with wide feet not less than five-sixths of their height. When the centers are in place a bar may be put through the hole B and props put under the bracket C, when even an awkward crane driver will be able to handle the flask without much danger of doing any damage.

Where the lifts are not too heavy it is possible to have the crane hoist up one side of the flask to a vertical position, when it may be easily brought over through a chain attached to the heavy side, which, of course, must be the top edge in this case; but where there are from four to eight tons of sand and grates sus-



pended, manual labor has but little effect and I suggest the use of the bracket or lever shown in Fig. 3, which is a simple casting 2½x3 inches in thickness and at least 6 inches in the narrowest part. This should be made about 18 inches long from D to E or longer if desired. At the length shown it will probably stand a pull of from 8 to 10 tons. The hole at F is for handling it by the crane as it is too heavy to be carried around by hand. Of course if there is no objection to a little extra expense a steel casting may be procured which is much lighter and stronger. When this is fixed in position as indicated and wedged up tight at G with iron packing, it should be attached on the light side of the cope to be turned over, if there is



any difference. If the flask is a long one or made up with loose bars, which is perhaps the best construction for this class of work, it may be necessary to use two levers and a beam. When the heavy side is lowered down and the

crane hitched to the lever by the shackle H and hoisted to the position shown in Fig. 4, a stout beam will hold the cope in this position when the crane may be slacked off and fastened to the other side and the cope hoisted to a level position. The whole operation will take up very little longer than it does to read this description.

If there are many cores to be fastened in the cope they may also be safely turned over by securing them after methods shown in Fig. 5, two timbers I being put through the flask bars and propped under the flask as shown, when the cores may be propped from the plank fastened to these and the cope turned back by reversing the method described above, without the risk of having any of the cores shifted. The jobs shown are quite plain, being simply used for the purpose of illustrating, but the principle is applicable to more elaborate work. It is necessary that the box sides should be strongly flanged and bracketed and in case of loose barred boxes the sides should be held together by a number of strong bolts.

H. SAYERS.

Foundry Management.*

BY DAVID SPENCE.

If a foundry foreman desires to keep his shop force up to a high state of efficiency he will as soon as he receives an order for castings, see that the necessary cores are at once ordered from the core department. Then he will proceed to learn if he has a suitable flask for the casting, and if he has, he will ascertain if any repair work is needed on this, and if so, he will have this done before the flask is taken to the molder's floor. All repairing of flasks should be done by a flask man instead of the molder and his helper. In order that the molder may use his time to the best advantage his helper should see that he not only has facing sand, gaggers, clamps, etc., but he should also look after the many little things which the molder sometimes spends his high priced time in looking up. Even in specialty shops I have seen molders take a hand in barring up flasks. This they should not have to do, as this kind of labor belongs to the flask maker, and the latter will do a better job than the molder every time.

In a great many foundries the men depend too much upon the foreman for everything. They should remember that he is only human, and has not the time to attend to every little detail. It has always seemed strange to me too, that the place where castings are made should receive so little attention from the owners of plants, a majority of whom seem to believe that anything can be made to do for this department. Perhaps nearly every practical foreman is familiar with shops where ordinary equipment is so scarce that the molders are spending a great part of their time looking for things of which each should have a plentiful supply. The successful foundry manager of today must not only be a practical molder, but also experienced in cupola practice or he is not fully qualified for the position. Of course he should be a man of good judgment, cool and pleasant, and while he should treat his men in a liberal way, he should not be backward about taking a firm position whenever this becomes necessary.

A competent foundry manager is worth a good salary and is sadly needed by many foundries who are attempting to direct shop affairs from the office through men of small experience, who are really not foremen at all. At the present time we have another drawback in our foundries in the form of incompetent pattern making. I have seen patterns come into a foundry made solid, when they should be split, and blank gears with hubs nailed on where these should be left loose. Again the foundry manager has his hands full to handle the traveling class of molders, who generally come into a shop without a tool and whenever they are ready to draw a pattern they will look around for a nail to drive into it, and then break a clamp in two so that they may have a substitute for a hammer.

Naturally the successful foundry manager will watch the little things and guard against waste as much as possible. A few years ago I took hold of a foundry where I found thirty tons of iron in the form of scrap buried in the ground. I at once had this dug up and dried and put through the rattler, when I used a few hundred pounds a day until it was all used up. Whenever owners of a foundry have a good foreman they should treat him right and give him to understand that they have confidence in him. When they furnish him what he requires to work with in the way of material and equipment, then, and not until then, have they got a right to look to him for results. There are today too many men acting in the capacity of superintendents of plants who should be flask men and I have seen many a foreman who was more competent to be su-

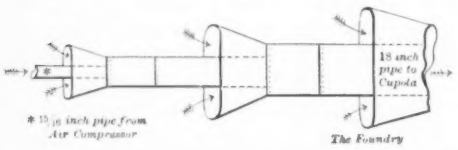
*Paper read at the Milwaukee meeting of the American Foundrymen's Association.

perintendent than the one who was placed over him. The young men of ability should be encouraged and promoted in every way, as it is to them we must look for foundry managers in the future.

A "Windy" Scheme that Refused to Work.

Various schemes have been tried for getting a supply of air into the cupola at a less cost than forcing this through a blower, but so far the blower holds the fort. The steam jet cupola, which was intended to draw the air into the melting zone by creating a vacuum in the upper part of the furnace made some great claims for economy at one time but failed to substantiate them when tests were made. Some time ago a foundryman conceived the idea that compressed air ought to be just the thing for melting iron, though it is difficult to see wherein there would be economy in squeezing the air together and then letting it expand to its normal volume again. It seems, however, that this inventor labored under the impression that a small amount of air rushing from the compressor at great velocity, would, if suitable openings were made in the blast pipe, suck in and carry along with it, a greater amount of free air. In this way it was argued that only a small volume of the air used in a cupola would have to be compressed, the balance being induced of its own accord into chasing the compressed air the minute this was let loose.

The apparatus by which this was to be



brought about took the form shown in the illustration. The pipe leading from the compressor was 15-16 of an inch in diameter, while the main blast pipe leading to the cupola was 18 inches. Through a series of funnel shaped pipes constantly increasing in diameter it was proposed to fool the air into flowing in the direction shown by the arrows, the original volume of compressed air being supposed to pick up considerable of the atmosphere which had not been cornered. The experiment was first tried when the cupola was empty and appeared to work pretty well, with the exception that it produced a noise similar to a large planing mill in operation. However, when the cupola had been charged and it came down to real business the scheme did not work worth a cent. The air seemed to back up in the pipes, a condition which probably should have been expected, and according to latest accounts this foundry is still using the ordinary blower.

HENRY MCALLISTER.

The Continuous Operation of the Iron Foundry.*

BY JOHN C. KNOEPPEL.

In writing on this subject the writer desires to be understood as not being antagonistic to this form of operating our foundries, recognizing as he does, the general progress of the trade in this country, as well as the inventions brought out to develop and cope with the demands for castings to meet the requirements of our customers. The fact cannot be contradicted that the foundries in this country are entering into an era of improvements and facilities gigantic in their proportions.

All of this naturally suggests to the advanced founder that the most economical ways and means to secure the best results are to operate the foundry continuously. In giving my views on this important subject I write from the standpoint of a practical molder and foundryman of over thirty years' experience in all lines of castings, and will at the outset make mention of several features that we as foundry managers should give careful and thoughtful consideration.

1st. Do the present conditions of the trade warrant the operation of the foundry on the continuous plan? 2d. Would this be to the best interest of the foundrymen in general as a paying investment? 3d. Would the expenditures necessary for the contiuous operation of the foundry give adequate returns? 4th. Would the output be of a better quality? 5th. Would not the continuous working of the foundry tend to increase the wear and tear of machinery, tools and cost of maintenance? 6th. Would the continuous operation of our foundries be beneficial and healthful to the workman and his family? 7th. Would it not become monotonous and have a tendency to decrease the capacity and ability of the molder and mechanic? 8th. Would it not have the effect of decreasing the qualifications and skill

*Paper read at the Milwaukee meeting of the American Foundrymen's Association.

of the individual molder and lessen the ambition of the young man who enters the foundry as an apprentice with a view of becoming a mechanic? 9th. Can the foundry be operated on a continuous basis successfully when we consider the present scarcity of all classes of labor, the rate of pay, and the demand and supply of work, all of which govern the successful operation of a foundry?

When we consider the general progress the foundry has made during the past ten or fifteen years, it is no wonder that many are inclined to the idea of operating a foundry on a continuous plan as being the most economical as well as profitable way of obtaining the best results and greatest returns. This subject is a very natural one and timely when we consider the enormous trend of business and the close competition in our products, taking into account costs, together with the possibility of a shorter working day and the desire of the molder to curtail his output. Under these conditions would the continuous operation of the foundry be profitable? As managers of foundries we are asked to pay an honest day's wages and in return we expect to obtain an honest equivalent of work per day. Do we obtain this and can we as foundrymen get it at all times? Are we not handicapped in many localities and forced by circumstances to hire men who are not capable and in this way increase the cost of our product? As foremen and managers our mission is to operate the works under our control so that we may give to our employers a fair interest on the money they have invested.

Under conditions as they exist at present we might be led to believe that a continuous operation of the foundry would be the best plan to follow in order to obtain the greatest returns. In a general way the writer is inclined to the opinion that the times are not yet favorable. In the continuous operation of a foundry the wear and destruction of machinery and tools would be greater in proportion, than under the present plan of operation and by continuous working the time for repairs would be limited.

Further, would the output of a foundry be of a better quality than it is under the present methods of operation and condition? Where large bodies of men are employed we find it a difficult matter to keep and hold steady men, and the more we have to employ the worse will this evil become. Then again where the same work has to be continued and performed by different shifts of men this does not always result satisfactorily and would consequently give more chance for mistakes and loss to the foundry.

It is also likely that continuous work in the foundry would be injurious to the health of the molder, as the fact remains that a molder working by natural daylight and under normal conditions can perform his work to better advantage and with less percentage of mistakes and loss than occurs where a foundry is working under a continuous plan or with two or three shifts of men.

The continuous operation of an iron foundry on general principles is not productive of the best results for the reason that the work is not performed uniformly well as under present systems, where the men are in much better condition to perform their work, and labor with greater zeal and ambition and consequently obtain better results. Continuous work is irksome and tiresome to the individual who needs his normal rest to reinforce him for the next day's labor, and the proper time to obtain this is during the night.

There would also be a tendency for other disturbing elements to arise, and mistakes would be liable to happen more frequently where two or three shifts of men are employed. The constant hustle and bustle in foundry work during the molding and casting, where this takes place at the same time, would naturally detract the attention of the men from their work, and as such would be the means of producing mistakes and accidents. An increasing number of patterns and flasks would also be required as well as a larger force of molders and helpers.

While the melting might be done continuously to accommodate the changed conditions there will be a tendency to increase the cost of repairs, and the installation of additional cupola capacity would mean further expense and the employment of more help. There will be bound to be more or less confusion where a large quantity of metal is being melted and handled and the foreman would require assistance to keep things moving in the right direction. In view of this increased cost of production will it pay to arrange and fit up our foundry to run continuously? In case of break downs, shortage of work or delay of any kind there will be losses which materially increase the cost of the output.

There is no question that there will be an increase in the number of foundries operated on the continuous plan, but in a general way it is doubtful if the majority of us are prepared

to take up this question at this time. The shortage of molders and coremakers has put the majority of the managers and foremen of foundries in a serious predicament and the introducing of continuous operation of foundries at this time would nowise remedy existing troubles. To overcome the shortage of capable men we are putting in molding machines and the very best improvements that can be secured, yet, it is to be remembered that before molding machines can be worked, men must be found to handle them. I believe we have a sufficient number of foundries in this country to handle all the business that has to be done under our present methods and conditions. Where foundries are being operated continuously and successfully it will generally be found that the product is under their own control and is being duplicated by the thousand. The demand which has existed for castings for the past four or five years is not likely to be with us always. What we need more than anything else is the proper management of our works, so that a larger output can be secured per man. This can be accomplished by constantly keeping the molder employed during the day and providing him with the proper tools and supplies in time.

It has been my experience that mistakes are largely due to work being performed on the same job by a number of men, or by different shifts of men. I have yet to see a molder who does not prefer to do his own pouring, and to my mind a very large number of castings, no matter how well the molds are made, can be and are lost through improper pouring, and so it is where more than one party is engaged on one job, the blame is always shifted to the other fellow, and hence the responsibility of the individual molder is lessened. No doubt the continuous operation of our foundries will be in line with future progress and shorter hours, and the reconstruction of foundry methods, but all of this is a new development upon which further education must be had for both employer and employe.

I am of the opinion that a much larger field is in store for the molding machine in the future, partly, on account of the scarcity of molders, which forces the manufacturer to avail himself of every practical invention brought out to reduce the cost of his castings. I have always found it a good investment to have the men out of the shop in time as they are then in a better mood and condition to resume their labors next day. In shops making it a practice of being late the men in general do not take kindly to this and we cannot blame them for it. Where the molders know that they will get home in good season, they will be more ambitious to accomplish their work on time and I prefer to allow them to go home when they are through casting. In my judgment, it is poor management to keep the men sitting around in wet clothing waiting for quitting time, and I find I can get more work out of them by treating them like men and be reasonable in all things. It is not always possible to leave the shop on time and where such is the case I find they are willing to help out when they know the circumstances. In my opinion the manager of a foundry does not have to exact the last minute's service from an employe in order to make money for his employer.

Melting Ratio in Brass Foundries.

Brass foundry practice relating to the methods of melting and mixing the alloys is a theme deserving the interest of manufacturers and tradesmen alike ; nevertheless, statistics and data illustrating the melting ratio of the various alloys, or the methods of dealing with the combining elements in the crucible, furnace, or cupola, are practically *non est.*

It is generally acknowledged that the vast amount of independent thought and experimental research which has been accumulated in determining the melting ratio of cast iron in the cupola, has led to a more economical system of cupola practice, as well as to a better understanding of the materials required to produce fluid metal in the best condition suited to the castings to be made. So much must be granted to the leaders in modern iron foundry practice and to THE FOUNDRY as the leading exponent of foundry technology.

By a long course of practice coke has been established as the ideal fuel for melting cast iron in the cupola, and iron foundries have benefited most by the discussion of the merits of fuels, and the economics of melting iron, for the foundry.

In the brass foundry things are different. Melting records, if they exist, are treated in much the same way as photographic plates—they are opened in the ruby light of selfish incandescence and exposed in the double-dark chamber of mysticism for the benefit of the operator. Brassfounders are the most conservative of foundrymen, they keep tenacious hold of so-called trade secrets to their own detriment, they are biased in favor of obso-

iete methods, and in many cases they must either be debited with a lack of interest or energy, or else a secret satisfaction with the legacy of their predecessors in the business. No one has yet dared to particularize any one fuel or mixture of fuels as the best for melting brassfounder's alloys. It would appear that the ratio of fuel required to melt bronze or brass alloys, or the influence of different fuels on similar metals or alloys, are subjects which have escaped the serious notice of the average brassfoundry worker.

The writer has frequently had occasion to melt the standard bronze (copper 90, tin 10) in crucible furnaces with natural and forced draughts, in reverberatory furnaces, and in the cupola, and his experience has proved that some fuels are better adapted to the respective methods of melting than others. For instance, charcoal is the most convenient and economical fuel for crucible furnaces having natural draught; coal is the best fuel for the reverberatory furnace; although the low cost of crude oil has led many manufacturers to consider its application to this class of furnaces; and coke is certainly the fuel best suited for melting in the cupola, the most expensive and uncertain of all the melting methods practised in the brass foundries.

Quick melting and the process of collecting molten metal on the hearth are against economy with alloys melting at from 1200° to 1800° F., besides in the cupola the fuel is in contact with the bronze, and gases and impurities are absorbed by the molten metal from the waste products of combustion. While it has been proved that the conditions of melting in the cupola have direct influence on cast iron, either in removing undesirable elements, or in building up the metalloids to a required standard, this quality is a decided hindrance to the successful melting of brass alloys in the cupola. To obtain satisfactory results the pressure of the blast must be lowered and the more fusible metals, tin, lead, zinc, must be mixed in the ladle instead of passing through the cupola to form the alloy. This adds another objection to the practice of melting bronze in the cupola, viz.: if the composition (tin, lead, etc) is added to the molten copper when it is tapped out, the resulting alloy is not so homogeneous as when the metals are melted together, as is done in the reverberatory furnace and in crucibles.

When we take into account the great variety of alloys in use, their peculiarities, and the high cost of metals, crucibles, and fuel, to produce them, we can readily understand how it is that no hard and fast rules have been established in brass foundries. Add to this the diversity in the character of the work, the lack of uniformity of methods in foundries producing the same class of work, and the difficulty of securing reliable reports of the amount of fuel used in melting metal, or the relative cost of fuel to metal melted in brassfoundries, is at once apparent. For some time I have been taking note of the melting ratio of one alloy (copper 9, tin 1), and also of the influence of different fuels and methods of melting on the same. The following table is the result of several observations and a comparison of many interesting points which may be helpful to the brassfounder:

	Metal Melted lbs.	Method	Fuel	Quantity Used lbs.	Loss in Melting, Percent.	Melting Ratio Per lb. of Fuel
1.....	400	Crucibles (N. D.)*	Charcoal	318	.89	1.25
2.....	400	" "	Purified Coke	300	1.22	1.33
3.....	400	" (F. D.)*	P. C.	348	2.18	1.12
4.....	400	" (N. D.)	Coal	325	1.04	1.20
5.....	17305	Cupola	P. C.	2184	7.93	7.91
6.....	2240	Reverberatory	Coal	1768	3.57	1.26

* N. D. Natural draught. F. D. Forced draught. P. C. Equal to Connellsville Coke.

In all the cases quoted above ingot copper and tin were used. Where crucible melting was the method employed, 200-lb. crucibles were used and about 3 inches of coke space was allowed all round the crucible. The fuel weights given include kindling the furnace and melting the metal *for castings*. Test bars were made from each sample, the best results being obtained from No. 2. The bars were turned to ¾ inch dia. No. 2 gave a tensile test of 19.4 tons per sq. inch with an elongation of 16 per cent in 10 inches. No. 5 gave 17.6 tons, with 14 per cent elongation; in this instance the tin was melted in the ladle and the copper was tapped from the cupola on top of that. In another trial, not given in the table, mixed metal was put through the cupola with very inferior results. The loss in melting was 10.14

per cent in a total of 27 cwt., and a test bar similar to those mentioned gave only 14.8 tons tensile strength and 8 per cent elongation.

After several other experiments with fuel, I am firmly convinced that bronze melted in a natural draught crucible furnace with a purified gas coke, will produce better castings than that melted by any other means. However this is only stated as a matter of practical observation, and not as an arbitrary law in the manufacture of bronze castings. Experiments with other alloys, conducted along the lines indicated, would assuredly make interesting reading, and if by close observation and examination we could arrive at a knowledge of the best fuel and conditions for melting and casting brassfounder's alloys, many of the trying anomalies of the testing shop would be obviated and more uniform and satisfactory results would be obtained in the foundry.

Touching the question of oil furnaces of a modern type, I am not in a position to write from experience. Some years ago I made a lengthy trial with an oil furnace (Rose's patent, Glasgow) and after repeated failures through dull metal, excessive waste and costly repairs I was obliged to discard it and fall back on the old crucible furnaces. However, many new furnaces have come out since then, and, if we can believe all the claims that are put forth by the makers, there should be a rush on them. My own opinion is that oil furnaces for melting brass *in crucibles* are a retrogression, while oil furnaces on the reverberatory principle can never hope to compete with crucible work *in foundries doing small fine brass castings*. This is confirmed by the recent additions to the list of oil or gaseous fuel furnaces for brass-melting. The melting records of the principal oil furnaces show that it requires from 1½ to 2½ gallons of oil to melt 100 pounds of metal, and the waste averages from 2 to 3.5 per cent. Here the cost is decidedly in favor of the oil melting furnace, but the main thing about which the foundryman is concerned is the quality of castings produced. Strangely enough none of the leading makers of oil furnaces have made tests of castings from these furnaces. Until then we need not wonder if the brassfounder steers shy of costly experiments on behalf of inventors seeking to found a new industry. Wherever forced draught or gaseous fuel has been introduced in crucible melting, the crucible question has been a sore one.

Coal is recognized to be the most congenial fuel for crucibles, but coke or charcoal is more convenient and more economical. Oil and gas are both preferable to solid fuels for brass-melting in reverberatory furnaces, if it can be shown that the quality of the metal produced is equal to that received by the older methods of melting. The heat is easier controlled, the space required for storage of fuel is less, a pipe or a tank taking the place of the coke or coal heap, and the price of fuel per 100 pounds of metal melted is so much cheaper that it behooves brassfounders who use reverberatory furnaces to inquire into the merits of some of the modern oil or gas furnaces of that description. If an engineer were confronted with a problem of this kind, he would reduce it in a twinkling to a formula. By means of some abstruse equation in algebra, he would prove that as so many heat units are required to melt a metal, the fuel best suited for the purpose is that which produces the required caloric in the quickest time at the lowest cost. But foundrymen know the uses of arithmetic better than to reverse the order of progress when dealing with purely physical phenomena. It is a remarkable fact that, while the metals have been discovered or confirmed in their characteristics by scientists, the bulk of the useful alloys have been due to the experiments and researches of scientific nondescripts. Babbitt, Muntz, Dick, Parsons, and many other inventors of alloys, were more deeply interested in the practical results than in the scientific effects of their experiments. The work of the "Alloys Research Committee" and similar bodies has not been the means of profit that it might, because it failed to consider the influence of fuel on metals in ordinary refining or brassfoundry processes. In contrast to this, it may be here pointed out that the progress which has been made in the past decade in electro-metallurgy has developed kindred sciences, notably metallography and crystallography, to such an extent that we are now beginning to understand the defects of the older systems of reducing metals. Pure metal is easier obtained by electrolytic methods than by any other, simply because there is no contamination in the source of heat or energy in the process of separation or combination. The increased demand and manufacture of *pure* copper is largely due to the cheapening of electrical methods for separating the metal from its impurities. The changes which have taken place in metallurgical methods and re-

fining processes indicate the trend towards purity in modern times. And now appears the point of this digression. Of what avail is *pure* metal *melted in contact with impure fuel?* Electrolytically refined copper should produce superior gun metal castings in the foundry, if melted and alloyed under suitable conditions, but if ordinary care and *inferior* fuel are used in the process of reduction, the chances are that G. M. B.'s or the common tough copper would give results equally as good. Pure copper absorbs impurities more readily in the furnace than impure, because the impurities in the latter, which are the result of environment in the raw state, or chemical affinity in the process of refining, tend to repel the further assimilation of extraneous matter. It becomes evident, therefore, that any attempt to reduce the melting ratio in brassfoundries to figures must also deal with the final condition of the metal when it has been turned into castings. To sum up, the melting ratio in brassfoundries is not a question of economy only; the nature and requirements of the work to be cast, and the effects of the fuel on the metal and the crucibles, or furnaces, are important factors in the ultimate cost and utility of brassfounder's castings.

JOHN F. BUCHANAN.

Loss of Sulphur in Cast Iron Borings.

BY W. E. DICKSON.

Some time ago I found myself obtaining high results in the determination of sulphur in pig iron. My method was the usual one of evolving the sulphur as hydrogen sulphide, absorbing the gas in an alkaline solution of cadmium salt, acidifying and finally titrating with a standard solution of iodine, the factor of which was obtained from results given by standard borings.

After examining all details of my work without finding any source of error, I made an examination of my standard borings and to my surprise, found that the standard, which was supposed to evolve .040 per cent sulphur, was only giving off .030 per cent. Thus, after putting a portion of standard borings through the regular process of analysis, I would divide .040 by the number of cubic centimeters of iodine required for the final reaction to obtain my factor. As the standard proved to be giving off only .030 per cent sulphur it is obvious that the factor would be one-third too high and all results obtained by its use correspondingly so.

Thinking the standard might have been improperly prepared, I made up another one, using every precaution to secure a good, clean, thoroughly mixed lot of borings. After establishing its sulphur value, based on the results of a number of chemists, it was carefully bottled and sealed and stored away with the exception of a small portion needed for frequent use in standardizing.

For a time this standard gave the best of results, but after a while it began to give a higher factor than that obtained by use of a steel sulphur standard which had agreed closely with it at first. Portions from the sealed bottles showed the same change and a careful re-analysis of the standard showed that it was evolving less sulphur than the value assigned to it while the steel standard gave the same as before.

Turning to a number of other standards in my possession I examined them and found a loss in all those made from cast iron. Those made from steel had undergone no appreciable change. The regular sample of the pig iron, preserved in the laboratory for checking in case results were questioned, showed a large loss of sulphur even though the time intervening between the first and later tests was short.

In borings of cast iron every particle is cracked throughout, becoming a porous mass—offering a very large surface for action of outside influences such as acids, when attempting to dissolve the material, or air and moisture in causing oxidation. On the other hand the soft steel rolls up in a compact lump presenting little surface for the action of such influences.

With this in mind it seems possible that the loss may be due to a slow oxidation of the sulphur taking place on the large surface exposed by the porous particles of iron while the surface presented for action on the steel is so small that it would be a long time before sufficient loss occurred to become noticeable.

Whatever the cause, I believe it is certain that borings of cast iron, even though kept with all of the care given to standards, lose very appreciable amounts of sulphur by standing and the widespread use of the above or similar methods for the determination of sulphur should cause the fact to be of interest to chemists engaged in the analysis of iron. Possibly others have noted the phenomenon before I did and have better ideas of the cause or remedies for it, but, to the best of my knowledge, it has never been brought out for discussion.

*Paper read at the Milwaukee meeting of the American Foundrymen's Association.

American and English Foundry Tools.

It has been assumed, says a contributor to the *Mechanical World*, that because wood molding boxes are largely used in America, therefore American molders are not as up to date as we, who no longer use them, are. I think I can explain why about 50 per cent of American flasks are of wood, but at the same time I do not wish to be suspected of being an American. I am not even a molder, but merely an English patternmaker. I have worked in American shops for a number of years, and would rather find fault with than crack them up, because they are over-estimated as it is, both by Americans and by ourselves.

Wood boxes are used, I believe, solely because it is a saving of time and expense to make them of wood. I do not think they are exclusively used in any foundry. The fact that iron boxes are also used and known everywhere is proof that the wood form must have some merit which keeps it in existence. The reason why wood boxes have gone out here is because our methods are more thorough. Here a patternmaker might spend a week on a large box pattern, planing taper and fitting in bars to clear the pattern, and two or three foundrymen spend at least a day making the mold, and considerable expense be incurred for material, all, perhaps, for a flask that would be used only once; an American carpenter would achieve practically the same result in probably not more than one day's work.

Many wood flasks are made with cast-iron ends flanged for bolt holes. If wood ends are used, long bolts are made to reach from one side to the other. The pieces of wood for the sides have to be procured, and beyond boring the bolt holes at the right distance in and trimming down the edges of the projecting ends to make the flask convenient for handling and lifting, there is practically nothing more to do so far as the frame is concerned, for no planing is required. It is bolted together, and the bars are put in. These also are quite rough, merely sawn to length, and the necessary amount for clearing the patterns sawn roughly out. This makes a cheap flask that is quite good enough for a few castings. The foreman decides what kind of a flask he will have, just as he decides on the style and finish of a pattern for a particular job. If it has to be used many times, an iron flask is superior to a wood one. The worst point about the wood form seems to be that it always gets badly burned at the edges when the gas lights at the sides in casting.

In the case of wood beams for lifting, of course the same argument does not apply; but I think wood beams are still as much used in this country as in America. I have seen plenty of them on both sides. It must be remembered that neither country is universally up to date. The chief difference is that England doesn't pretend to be, while America does.

The different conditions prevailing in the two countries must also be borne in mind. England is a great iron-producing country. America is only just beginning to discover its iron, and most of what is used there is of inferior quality to English. In England timber is comparatively scarce. In America until recently it has been plentiful, and has been used wherever possible in place of more expensive material. Not only that, but owing to the drier climate of America it is possible to use wood with satisfactory results for many purposes for which we could not use it. Bicycle rims provide an example. Wood rims in this country are a failure, and yet in America they entirely displace steel. In many things which are done quite differently on each side of the Atlantic it is scarcely a question of which is most up to date. There is often nothing to choose between two ways of doing a thing, and on the whole the American has less prejudice against a new method.

Shall Foundry Responsibility begin in the Designing Room? *

BY F. W. STICKLE.

By the usual methods followed in our manufacturing establishments if a new machine is to be designed it is many times given to a technical man who never was inside of a real foundry a dozen times in his life. He has no knowledge of the difficulties the foundryman has to contend with day after day and he proceeds to make a picture of the machine, which suits his taste, in utter disregard of the difficulties which may later arise in the construction of his design.

When the details have been attended to in the drawing room, the drawing is sent to the pattern shop where the boss patternmaker gives it to a workman to attend to, and it is

*Paper read at the Milwaukee meeting of the American Foundrymen's Association.

not at all likely that there are two workmen in the pattern shop who will make a pattern the same way. Up to this time there has been no limit placed upon the expenditures, there has been but little thought given to its cost, and no expert judgment used in general. As soon as the pattern reaches the foundry cost keeping begins, and the general quality and fine appearance of castings are noted. Here is where the foundryman's troubles start, as possibly the design should have been made into a master pattern, from which a metal pattern should have been cast to obtain the best results at a reasonable cost, but no one has ever given this feature a thought and of course it is out of the question to go back and make another pattern, so the man in the foundry must use the pattern as it is at the cost of his reputation and be eternally abused because the castings are not as they should be.

Slight variations in the lines of design or a few alterations in the construction of a pattern will simplify the most complicated job so that it will be a pleasure to turn it out for both the foundryman and engineering department, and if these things had been considered in advance the outlay of much money could have been avoided. Another very important thing in the making of patterns of a similar type is to fit these up so that the rigging on hand can be utilized instead of having to make new and expensive preparation for every new pattern which comes along. A further factor is the equal distribution of stock to avoid shrinkage strains and sponginess. As a rule, patterns that can readily be cored are left to be drilled, while others are left to be cored just where this adds risk and labor amounting to far more than the stock removal would cost, should the core be omitted. In the jobbing foundry these conditions are met with almost continually and it is a common charge that no two foundrymen want a pattern constructed alike; admitting this to be the truth, if pattern makers ever made two patterns alike, perhaps the foundryman would be able to establish a right way of doing things also.

Another feature I have found in some manufacturing plants, and which I have never been able to understand, is that the foundry is expected to break up a well regulated big floor any time the machine shop thinks it needs a casting in a hurry, and it matters not if there are three hours molding time lost and half a dozen laborers employed in making the change. After all this trouble it very frequently happens that we find this same casting lying around the shop for a month unused. There is no place where interference with the regular day's work means more in the increase of cost than in the foundry. Many a time have I found myself wanting a small job done in the machine shop, which was very important, when I have been informed that they could not stop to change a machine until the job it was doing was finished, and this too when the work was only suspended on the two centers of a lathe with a dog attached. I am sure it could have been taken out in one minute without any assistance. I simply want to call attention to these facts for the consideration of our friends who are devising red tape schemes to reduce foundry costs. I will further add that the excellent results obtained from molding machines are more due to not interfering with them than to the actual capacity of the machines themselves, and why should we not give as much consideration to our mechanics as to our machines?

Some Little-Known Molding Machines.

BY E. A. FAY.

It some times happens that meritorious inventions, for one reason or another, remain obscure and unknown for years. Such seems to be the case with a certain kind of molding machine designed for molding small articles of simple construction in a very rapid manner. In this type of machine a large number of patterns are mounted on the lower side of the plate and are forced into the molding sand from above. The original inventor of this idea is unknown to the writer, but it was mentioned by S. S. Campbell and J. Goodwin in a patent in 1862. Figure 1 shows an idea that was advanced about 20 years ago by James Lutted. The pattern plate was hinged at A, as shown, and carried a short bolt passing loosely through the plunger B so as to permit the patterns to be drawn by the straight upward movement of the crosshead, as will readily be understood. This plan has some obvious objections but might be useful in certain kinds of work. The flasks, previously filled and smoothed off, were passed along on a table by means of a feeding mechanism operated by power and automatically stopping them under the press head, which was also automatically operated at the proper time.

In 1889 C. B. Overbaugh suggested several new features; an endless chain intermittent feed for the flasks, a cam for swinging the plunger to one side after drawing the patterns

to present them to a wiping device and allow inspection, venting through the pattern plate, and a method of attaching the pattern plate to the plunger so that this could easily be substituted by others carrying different patterns.

In 1894 D. M. Holmes, of Arlington, N. J. provided these machines with a small hammer, automatically vibrated as soon as the compression began to take place, to aid in packing the mold. His cam for forcing the pattern plate down was so shaped as to withdraw the patterns slightly and then print them back, the

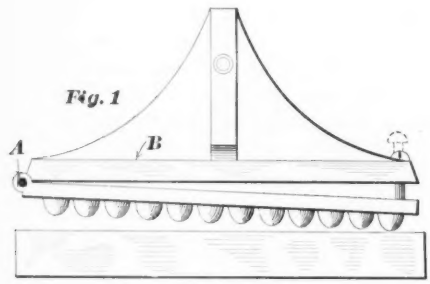


Fig. 1

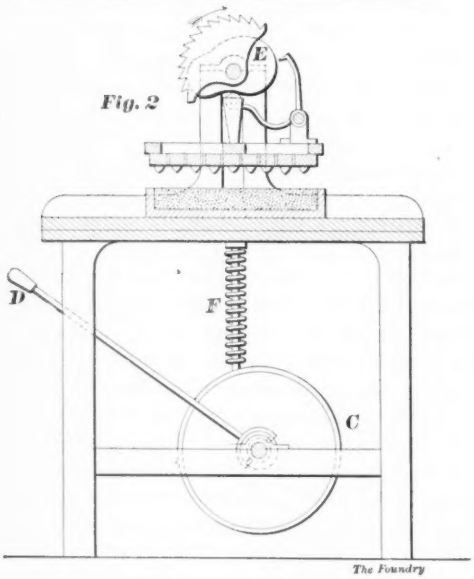


Fig. 2

hammer operating all the time. The advantages of this are obvious. Fig. 2 shows a sectional view of this machine. It was run by a belt on the pulley C, and started by lever D. A sprocket chain transmitted power to the cam E. The springs F, at both ends of the frame, held rollers in contact with the cam and therefore forced the pattern plate up whenever the cam permitted. The vibrating mechanism does not seem very satisfactory, but it must be remembered that it is designed exclusively for small work.

Another idea in vibrating devices that is obviously not suitable for large work was to place a spring bar flat on the top of the pattern plate and fasten it down at one end, the other end being attached to a vibrating pivoted bar by a flexible connection that would permit it to snap down on the plate when released by the bar. The bar was worked by a ratchet wheel. The press head was adjusted by means of hand wheels on each end connected together by a sprocket chain so that both ends would be raised and lowered the same moment. By a peculiar arrangement of gearing the press head was moved more slowly as it got down to the point of starting compression, and more rapidly as it receded. The vibrator was mounted on the press head and automatically started when the head was depressed. The inventor was Gabriel Carlson of Springfield, Mass.

In order to avoid the necessity for the cams of his earlier machine and the jarring devices mentioned, D. M. Holmes has recently designed a machine involving an idea that was suggested some time ago by S. H. Stupakoff. It will be remembered that Mr. Stupakoff proposed to give the pattern a slight horizontal eccentric rotary motion to free it from the sand, using an eccentric mounted below the pattern plate. Holmes' machine, like the others mentioned here, employs a pattern plate descending from above, and he produced the required motion by using upright guides for it which are eccentric and are revolved at the proper time, being journaled in the frame of the machine. The machine is provided with a shelf or table projecting from each side. The flask is placed on the front one and is automatically carried into the press, and, after compression, is carried out onto the rear one. All the operations are automatic.

I neglected to state that all of these machines were designed primarily and exclusively for making molds in starch or flour which are used for molding chocolate creams and other confectionery. It is notorious that men who have devoted their lives to one art or trade usually know absolutely nothing about what is being done in kindred ones, to say nothing of those which, though not closely analagous, yet have some similar features. For example, molders and foundrymen usually know very little about glass making, although

many of the operations are similar, and some of the implements could with simple and obvious changes be used in a foundry. Of course, no molder would think of going to a confectionery shop to get ideas about his art, but it has been shown that there is one operation performed there that is similar to one of the most common and important performed in foundries, and that the molder who would go there would see it carried out in a not greatly different way. The confectioners ran against the same difficulties in their machine molding that the founders did and presumably working independently, they solved them in much the same ways. One thing to be noticed, however, is that they did not find it necessary to try the stripping plate, or did they not think of it? They were probably saved from it by the small size of their patterns.

Foundry Work at Worcester "Tech."

In discussing the value of a technical education at a recent meeting of the Foundrymen's Association at Philadelphia, Dr. Edmund A. Engler, president of the Worcester Polytechnic Institute, Worcester, Mass., presented the following in a paper on "Foundry Work at the Worcester Polytechnic Institute":

"All that has been said with reference to the work in the machine shop applies with equal force to the work in the foundry. Here also the student receives systematic instruction in foundry practice which extends through all years of the course of study, and is so graded as to make most effective the training which he receives in other subjects, such as drawing, descriptive geometry, pattern-making and chemistry. He is taught the names, grades and characteristics of materials, tools and appliances used; simple bench molding; simple core work; making and using plaster of paris plates or match boards; floor work in green sand; use of three and four-part flasks, false cheeks, etc.; advanced bench and by bedding-in; use of sweeps, part-patterns, etc.; advanced molding and core making; dry sand work, charging and care of cupola; mixing and testing metals; brass molding, and advanced special work; the whole occupying for each student more than 400 hours under expert instruction.

"This work is now conducted in the new and thoroughly modern building, completely equipped with the latest appliances and conveniently arranged with a view to securing the best results with the least expenditure of time and energy, and under the best possible sanitary conditions as to heat, light and ventilation.

"The new foundry, with its excellent equipment is, like most installations in educational work, an evolution from the simplest beginnings, from which it has grown gradually as the importance of the work has demanded. Never in the history of the art has the importance of founding been so universally recognized in the engineering world as it is today. The Worcester Polytechnic Institute, quick to note this awakening interest in founding, was among the first institutions of its kind to offer its engineering students a comprehensive course in foundry instruction. Its first attempts in this direction included casting in white metal only. Some of its older graduates will remember the little crucible furnace and the few wooden benches, or troughs, which at one time constituted the 'foundry.' This plant was located in the wood-working department, but, crude as it was, its installment marked the beginning of a movement which has grown by what it fed on into considerable proportions. Later, a reasonably complete little foundry was established in an ell of the Washburn shops, with a very respectable cupola, as well as crucible furnaces, core oven, traveling crane and other facilities. This little foundry became popular from the start and the work done there, both educationally and commercially, soon outgrew its very limited quarters. It was from this state of things that the necessity for a new, and larger and better equipped building arose, and this necessity has been met by a contribution of generous friends of the Institute who have provided the means necessary to erect and equip the splendid foundry building which the students at the Institute now enjoy.

"The building which has been erected for foundry purposes is 90 feet long and 52 feet in width. Its frame is of steel, and its outer walls, which are 21 feet high, are of red brick with sandstone trimmings and granite underpinning. Its roof is covered with gravel, and has a monitor 8 feet high, 21 feet wide and 72 feet long. This monitor is amply provided with windows which can be quickly adjusted for ventilation. The outer brick walls of the building also have a good number of unusually large windows, which make the interior exceptionally light and airy. In general appearance the building harmonizes with its surroundings.

"The interior arrangement is as follows: On

the east side there is a gallery 11 feet high, 15 feet wide and 90 feet long—the length of the building itself. A small private office is located at the north end of this gallery, and at the south end there is a power room 10 feet wide and 15 feet long. Portions of this gallery are made exceptionally strong for heavy storage, and the central part serves as a charging floor. The stack room is directly under this central portion and is enclosed by brick partitions. It is 14 feet wide and 24 feet long, and contains two cupola furnaces. One of these furnaces was designed at the Washburn shops and has been in successful operation there for the past six years, in the little foundry before referred to. It lines up at 26 inches and is capable of melting a ton and a half of iron per hour. The other furnace is of the Whiting type, and is at present lined up at 32 inches, although it can be increased to 37 inches. This cupola will melt from three to five tons of iron per hour. Besides these two cupola furnaces there are in this room two crucible furnaces. A 3,000-pound hydraulic elevator works between this stack room and that part of the gallery which serves as a charging floor, and is accessible from an outside door on a level with a driveway between the foundry and the Washburn shop.

"The pickling plant is on the ground floor just south of the stack room. The system requiring a stationary platform has been adopted. The vat itself is of solid granite floor work; construction of pits or beds; green sand molding and is located between the platform and the catch-basin, just within reach of the drip from the platform. The trough which conducts the water from this drip to the catch-basin when the castings are being washed, is attached to, and forms a part of, the cover to the vat. This arrangement obviates all danger of loss of vitriol through the negligence of the operator. He cannot get at the interior of the vat to dip the vitriol without taking off the cover and with it the trough leading to the catch-basin, thus necessarily removing all possibility of the surplus vitriol wasting from the platform into the basin and thence to the sewer. The southeast corner of the foundry is occupied by the rattlers, and between them and the pickling plant the castings receive the preliminary cleaning.

"A tunnel, 6 feet wide, 7 feet high and 36 feet long, leads from this part of the foundry to the basement of the north wing of the Washburn Shops. All castings pass through the tunnel for their final cleaning in this basement. A coreroom is situated at the southwest corner of the foundry. It is 15 feet wide and 32 feet long, and is divided from the molding floors by brick walls only two and one-half feet in height, high enough to prevent the sands of the core room from mixing with those of the molding floors, but not high enough to interfere with the light or the successful working of the heating and ventilating systems. This room is fitted up with core benches and shelves for finished cores, and a core machine.

"The core oven is near the south wall of the building and forms a part of the east boundary of the core room. It has the following interior dimensions: Seven feet wide, 6½ feet high and 12 feet long. It is fitted with double doors, adjustable shelves, and a heavy truck for large cores, and the Millet system for small work. The fire-pot is accessible from the exterior of the east end, which is nearest the coal bunkers. Openings in the interior flues are so arranged with dampers that the heat can be conducted to different parts of the oven as desired.

"The room for casting in brass and other compositions is located under the north end of the gallery adjacent to the stack room, and like the core room, is divided from the main part of the foundry by a low brick wall. It has the same width as the gallery itself, 15 feet, and is 32 feet long. A trolley connects this room with the crucible furnaces.

"On the main floor of the foundry the portion on the west side extending beyond the monitor is devoted to bench work and the entire portion under the monitor is used for floor work. A five-ton traveling crane works over this central portion covered by the monitor, and is so designed that, as the demands on the foundry increase, this crane can be divided into two independent cranes, each having one-half of the capacity, or two and one-half tons, and a heavier crane can then be added. Besides the traveling crane there is a one-ton jib crane located near the southwest corner of the stack room. It will reach to the large cupola and will swing over a portion of the molding floor, cleaning room and pickling platform.

"The building has four outside doors. One is at the north end and is sufficiently wide to admit a team. The other three on on the east side. The most northerly of these three leads to the gallery and to the main floor of the foundry. The other two are for freight. The central one leads to the elevator and that farthest south to the gallery. The driveway at this point is of such height that a cart standing there is level with the gallery floor. The

building is lighted throughout by electricity. Besides a generous supply of the ordinary 16-c. p. incandescent lamps, four, three-glower, 144-c. p. Nernst lamps are used with excellent results.

"The indirect system of heating has been adopted. A 70-inch Sturtevant fan, located in the power room, draws either inside or outside air between the pipes of a steam radiator containing 1,800 square feet of heating surface, and distributes it at the desired temperature through long sheet iron pipes to different parts of the building. In very warm weather or during the time when the men are pouring off, cool air can be thus circulated throughout the foundry.

"Besides the fan referred to, the power room contains a No. 7 steel pressure blower, and a fifteen-horsepower electric motor. The pressure blower supplies the blast to the two crucible and two cupola furnaces in the stack room, and the motor drives the entire plant, including the rattlers which are on the ground floor below. By an ingenious arrangement of clutches any part of this plant can be thrown out of action without disturbing the other connections. Two Morse flexible chains are used in these different drives and although one is laboring under the full load on the motor and is traveling at the rate of nearly 2,000 feet per minute, and the other is driving the steel pressure blower at 2,300 revolutions, both are giving very satisfactory service.

"The connection of the foundry with the basement of the north wing of the Washburn Shops by means of the tunnel renders this basement a most convenient adjunct to the foundry itself. In it are the water closets, wash and locker rooms; the room for cleaning and storing castings; the bunkers for core sands and molding sands, coal, coke and other foundry supplies. In the near future a trolley will be constructed which will extend from this basement, through the tunnel, into the foundry. Without this basement, but including the gallery, the foundry contains 4,896 square feet of floor space. With the basement, or that part of it which is practically devoted to foundry purposes, the total space available to the foundry department amounts to 7,324 square feet.

"With the equipment just described, and shown by the illustrations, it will be seen that opportunities are offered the students of the Worcester Polytechnic Institute for genuine instruction in foundry practice under the most approved conditions. Not only are they taught all the various processes of foundry work, but they are constantly under the care of competent instructors, and in the presence of some dozen journeymen who are engaged on commercial work which is constantly before them and about which they cannot fail to learn."

Tinning Cast Iron.

To be successful in coating with tin the castings must be absolutely clean and free from sand and oxide. They are usually freed from imbedded sand in a rattler or tumbling box, which also tends to close the surface grain and give the articles a smooth metallic face. The articles are then placed in a hot pickle of 1 part of hydrochloric acid to 4 parts of water, in which they are allowed to remain from one to two hours, or until the recesses are free from scale and sand. Spots may be removed by a scraper or wire brush. The castings are then washed in hot water and kept in clean hot water uptil ready to dip. For a flux dip in a mixture composed of 4 parts of a saturated solution of sal ammoniac in water and 1 part of hydrochloric acid, hot. Then dry the castings and dip them in the tin pot. The tin should be hot enough to quickly bring the castings to its own temperature when perfectly fluid, but not hot enough to quickly oxidize the surface of the tin. A sprinkling of pulverized sal ammoniac may be made on the surface of the tin or a little tallow or palm oil may be used to clear the surface and make the tinned work come out clear. Some operators again dip in a pot of hot palm oil or tallow at a temperature above that of the melted tin, for the purpose of draining the excess of tin and imparting a smooth, bright surface to the castings. As soon as the tin on the castings has chilled or set they should be washed in hot sal soda water and dried in sawdust.—*The Metal Worker.*

The business of George Lannon, founder, Pueblo, Col., has been incorporated, with a capital stock of $150,000, as the Pueblo Foundry & Machine Co.

Durant & Son have purchased a machine shop at Tomah, Wis., to which they propose to add a foundry at an early date.

The foundry at Chittenango, N. Y., owned by the late Peter Walrath has been sold to his brother, Jesse Walrath.

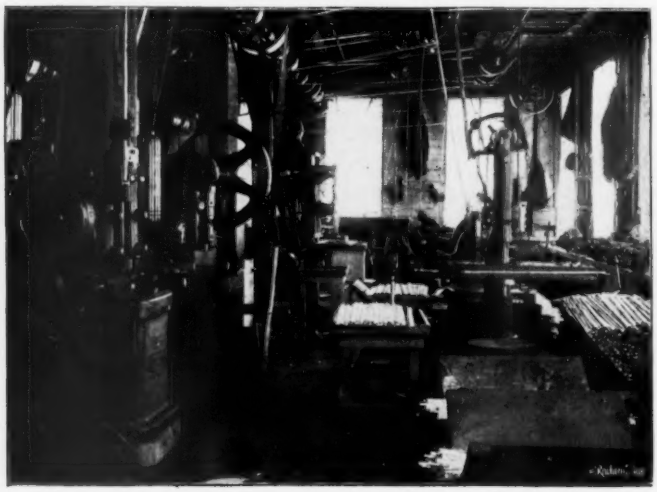
A Novel Manufacturing Plant.

The plant of the O. M. Edwards Co., of Syracuse, N. Y., is exceptional, not in its size, but in its completeness and in the fact of its location in the residence portion of Syracuse, far from any other manufacturing establishment. Its site is included within the grounds surrounding the residence of Mr. O. M. Edwards, in the midst of green lawns, shrubbery, flower beds, etc. The building is designed and painted to conform with the residence upon the grounds, and in external appearance would not suggest the existence of a factory in the vicinity.

Within, however, is a scene of activity. The number of employes is 60 and the articles manufactured consist of brass and bronze window locks and fixtures, shade rollers, sash balances and extensions, platform trapdoor fixtures. The building is 83 feet in length by 60 feet in width. In the basement are located the brass foundry, the tumbling barrels for both iron and brass, the grinding, buffing and polishing room and a complete gas equipment. Gas furnaces as well as ordinary furnaces are provided for melting. The building is heated by two hot-air furnaces placed in a battery system, with a fan located in the cold-air box. This fan has capacity to change the air throughout the building every 20 minutes, and is used both for heating the building in the winter time and for ventilating in the summer time.

O. M. EDWARDS CO.—FACTORY AT SYRACUSE, N. Y.

The work is planned to start in the basement, where the foundry is located. The castings are then tumbled and pass into the grinding room. From there they pass to the first floor in the machine room, then to the plating room and lacquer or tinning room upon the third floor, and then either direct to the stock room upon the first floor or to the assembling room upon the second floor, then passing to the stock room. The character and finish determine the course, which varies with different metals and finishes. The arrangement is such as to require as little handling as possible in the course of the work through the factory.



O. M. EDWARDS CO.—BRASS MOLDING ROOM.

The Larimore Rotary Engine Co., of Modesto, Ill., has been incorporated with a capital stock of $10,000. It is intended to erect a complete manufacturing plant, including a foundry. The company is composed of J. W. Larimore, W. K. Mertz and T. B. Wright.

Buying Pig Iron on Specification.*

BY HERBERT E. FIELD.

We are again fact to face with a declining pig iron market and some are prepared to take advantage of the drop in price of material to fulfill contracts based upon the higher prices. Others, however, are now receiving iron bought at a high price for previous delivery and are fearful lest the decline in raw material be accompanied by a like drop in the price of castings.

We have little sympathy with the man who, from lack of foresight, finds himself with a large amount of high priced iron on a declining market. We have sympathized with the one who foresaw the rise and bought liberally to cover future needs and then, through failure of the furnace in filling the contract, was forced to buy spot iron at top of market price to use in place of the iron contracted for at a much lower figure.

The use of specifications in buying pig iron is becoming quite general. An old saying that "A little knowledge is a dangerous thing" applies in the iron business as well as elsewhere. But let me change it a little: "A little specifying is a dangerous thing," and it will stand very well as a text in the present instance.

Some pig iron furnaces have, in previous changes in the market, found excuses for failing to fulfill contracts. We have, however, given them better excuses by placing analytical specifications in their hands. Some of them have been quick to make use of the excuse. Previous to the last phenomenal rise in pig iron, many buyers, taking lessons from previous experience with poor iron shipped from furnaces forced beyond their capacity, very shrewdly bought their iron upon specified analysis. They were sure then to get good iron, or they could reject it. So far so good. Let me illustrate how this turned out in many instances. The founder bought at a low price, say $16.00 for future delivery. The time comes for the delivery. If he gets it he may find it does not come within the specifications but is inferior iron. He complains and is very politely informed that the makers are most sorry, and that they will see that the iron is taken out, as they have a customer for just that grade. They agree to replace it with iron within specifications but the furnace is running "off" a little just now, coke is bad and scarce, and their furnace is running on a lower grade. As soon as it rights itself they will ship the desired kind. They regret the circumstance and are sorry to inconvenience their customer, etc., etc. You have all read it and heard it; have dreamed it as you saw your iron pile grow low and the price grow high. Your faith in human nature increases as you weep in sympathy with the furnaceman in his sorrow at not being able to supply the grade that you must have. You can see how pained he must be that he really cannot make the iron which he must sell you at $16.00, but that he can only make a lower grade and sell it on the increased market at $20.00 to $22.00. You can see how hard it must be for him when he is forced to accept $4.00 to $6.00 a ton more for a No. 3 when he really could be making a No. 1 or No. 2 at a greater cost and selling it to you for less money. What are your specifications worth now? You must buy a high grade iron to mix with it or stand the complaint of your customers on account of inferior castings. If you order the iron to be taken out, you must buy iron to replace it at a greatly increased cost and your foresight in buying on a low market nets you nothing. Some of you may say that such a one was fortunate to get any iron at all. It would almost seem that some furnaces purposely run on grades which could not fill the wants of their customers and then sold the product at a better price than they would have received on their contract for the higher grades. It is difficult to resist the temptation during such times to run furnaces beyond their capacity for making high grade irons. It is a strange coincidence that when the price drops below that for which the iron was contracted, the furnace generally gets "on" again and makes a few hundred tons just to fill the order. You are glad to see it coming, especially if you have filled your yard with iron at a high price. You realize that if it had come in when it should you would have been thousands to the good.

You say these have been exceptional times. They surely have. Two such times in 6 years should furnish about all the experience that is necessary. I bring this subject up for consideration at this time in hopes that foundrymen will do something to prevent a third.

That furnaces can fulfill specifications is shown whenever the supply exceeds the demand and there is competition for orders. There may be a certain satisfaction at such times, in refusing to take iron which does not come up to specifications, but this does not tend to a steadiness which is best suited for prolonged prosperity.

*Paper read at the Milwaukee meeting of the American Foundrymen's Association.

We hear repeated statements that the modern furnaceman is not only willing but anxious to sell by analysis. To be sure this anxiety is often proportionate to the amount of iron he has to sell.

Let us, however, assume for discussion's sake that the furnace can and will sell by analysis. Specifications and standards are two of the key notes in modern industrial advancement. The American Foundrymen's Association has for some years realized the importance of standards in up-to-date foundry practice. It has laid a foundation for the testing of cast iron and the work of its standardizing committee in preparing standard samples for analysis has given the association a world wide reputation in that line. The Metallurgical Section is at present working on standard methods for analyzing iron. Standard methods for sampling pig iron have been submitted to this association for approval. Standards tend toward stability, and anything which lends stability to business, whether it be stocks or foundry business, should be encouraged. Will standard specifications for the purchasing of pig iron overcome the difficulties which so many have experienced in the last year or two?

The American Society for Testing Materials has appointed a committee to take up the matter of standard specifications for pig iron. The writer desires, if possible, to introduce a discussion among the users of pig iron in order to bring out the sentiments of those who will be the most benefited by such specifications. Specifications may look well in print; they may show the best thought of the experts engaged in drawing them up, but they will be useless unless they are given the support of the buyers of pig iron. Will it be possible to draw up specifications which will cover emergencies and prevent the difficulties to which I have previously alluded. If this is not possible then they will not be worth the paper on which they are printed, to say nothing of the labor of getting them up. As matters stand now in the pig iron business, when the supply is equal or in excess of the demand, if a foundryman knows what he wants, he can get it without regard to standard specifications. If, however, the demand exceeds the supply, and the market is rising, the purchaser is pretty apt to take what the furnaceman sends him and be very glad to get iron, regardless of whether it fills the specifications or not. The utility of specifications will depend upon two facts, first, the inherent value of the specification itself, in being so framed as to prevent the above difficulty, and second, the support given the specification by the purchasers of pig iron.

What range in analysis shall constitute each grade? How great a variation shall be allowed from the specifications? What shall determine the true grading of the iron? How shall it be sampled and analyzed? These are a few of the important questions to be covered by specifications, but they are not enough. Specifications must be framed so as to guarantee to the founder the product that he has bought. If iron is bought at a contract price on a guaranteed analysis, the order should include a clause which gives the buyer an option to accept or refuse the iron if it does not come within the guaranteed specifications. It should go further, it should give the buyer the privilege of accepting the iron at a reduced price; the reduction to be covered by the specifications and not left to argument after the trouble has appeared. For example, a purchaser buys pig iron of a guaranteed silicon of 2.50—3.00, sulphur—.03, phosphorus—.7, etc. When he receives this iron he finds it runs 2 per cent in silicon, .06 in sulphur and 1 per cent in phosphorus. The purchaser should have the option of a fixed reduction in price guaranteed by the specifications. The price should allow him so much per ton reduction for every .25 of 1 per cent in silicon that the iron falls below the specifications. It should allow him a fixed amount for every .01 of 1 per cent of sulphur and every .1 of 1 per cent of phosphorus by which this analysis exceeds the guarantee. The benefits to be derived from such a specification are obvious. In the first place it would make the furnaceman more careful in selecting the iron to fill such orders. He could not feel assured as many have been able to in the last shortage that the iron would be accepted and paid for whatever it was. In the second place, it would give to the purchaser a reduction in price which would repay him for the excess in per cent of pig iron that he was obliged to carry in his mixture, or it would allow him to purchase high silicon, high manganese or low phosphorus iron to mix with the inferior iron and bring it up to the required standard without increasing the cost of his mixture. Such specifications would overcome the chief difficulties which founders have experienced in buying on specified analysis. These difficulties, as stated earlier in the paper, consist of the indifference which furnaces have shown in fulfilling specifications in rush times, and the use which they have made of the specifications to excuse them

for not shipping iron bought at a low price, when the price has advanced. If the furnacemen said that they could not make iron within the specifications on account of the hundred and one reasons well known to you all, you would have the privilege of telling them to send you the best they could, but at a price fixed by your specifications and depending upon the variation from the guarantee. This reduction in price should be proportioned in such a manner as to cover the cost of iron used in bringing the mixture up to specified analysis.

I do not claim that such a course would completely overcome the difficulty. There are dishonest people in the pig iron business, as well as in the foundry business. If you have bought low and the furnaceman does not intend to ship you iron on a high market, there has yet to be found a means of forcing him to do so. There is, however, a course open to you when he does desire to fill your order on a falling market, viz., to refuse it on the ground that it was not delivered at specified time. This leads to a third clause which should be included in all specifications. If the pig iron is not delivered in the specified time, the buyer should have the privilege of canceling the order. This latter course is frequently taken advantage of regardless of agreement, but our pig iron friends have hard names and feelings for the ones who take the privilege. Included in the specifications, it would form a part of the contract and would be expected, and thus would form an incentive to the furnaceman to fill his contract on time.

Just why the furnaces have been given such leeway is a matter which puzzles many. A furnaceman may sell iron way beyond the capacity of his furnace and then expect sympathy when some firm whose orders he has failed to fill in guaranteed time, and who has had to purchase iron at a much higher price, declines to take the iron on a falling market. I think that we all appreciate the difficulties under which a furnaceman works; in fact, I think our pig iron friends have taught us to over-appreciate it, and that the furnaces take advantage of this fact many times. Modern blast furnace practice makes possible the production of a more uniform grade of iron than the old regime could accomplish. We have a right to expect and require more of the furnaces, but do we? A furnace running well within its capacity with the proper amount of fuel and the proper amount and kind of ore and flux, will produce a certain grade of iron. A furnace run beyond its capacity with the object of increasing its output may produce a fairly good grade of iron, but the furnaceman tells me that a furnace pushed in this way is much more apt to run "off." The founder is thus often expected to accept the explanation that the furnace is running "off" as some mysterious condition wholly beyond the control of the furnacemen, when in reality it is too often due to a desire to get more from the furnace than it will produce, or to the fact that the rise in price has made it possible to sell the increased output of the off product at a higher price than they would have obtained for their higher grades.

We are often told that iron bought under such strict specifications would be more expensive, and that the furnaceman would be forced to get a higher price for his iron. I am not so sure that this would be the case. When the market is normal and the supply and demand are somewhat equal, competition will accomplish all that specifications will. It is during the shortages such as we have recently experienced that our specifications would prove a restraint upon the furnaceman and if appearances are correct, they could stand a little slicing of their profits and still remain solvent.

Let us admit, however, that there would be a slight increase in the cost of iron sold under specifications. Would it not be more than counterbalanced by the security that a buyer would feel in knowing that he would obtain the iron for which he had contracted or an equivalent decrease in price on another iron? The unhealthy, unnatural rise in price of iron, together with the inability of the furnace to fulfill contracts, has led to a heavy buying of foreign iron, and a consequent reduction in the price of the home product. Anything which tends to a steady, uniform price should be welcomed by both producer and consumer. It would be a great advantage to the founder to be able to make prices on castings, knowing that the pig iron would be delivered according to specifications. This would more than compensate for the slight increase in price which the furnace might be obliged to obtain for iron sold under such specifications.

So much for the specification itself—let us consider for a moment its use. A concern makes out a set of specifications for its own use. The furnace sees in them requirements which it is not obliged to meet in order to get business, and the specifications are refused or a price quoted which makes the placing of the order impossible. This would be the result of any radical change in pig iron specifications advanced by one firm alone. In order to guar-

antee their success the specifications must come as a general demand from a large number of foundrymen. This association, standing as it does as the representative of the foundries of this country, could make such a project a success.

In order to successfully introduce such specifications, the time must be opportune. Such a time is evidently at hand. I do not believe that the foundrymen of this country care to go through a third experience to teach them that something should be done to prevent a recurrence. Standard specifications with restrictive clauses, backed by the universal demand of foundrymen for their fulfillment, would be a long step in solving what has turned out to be a very difficult problem.

Cupola Air Supply.

In all cupola furnaces rapid melting is desirable, as this causes the smallest amount of alteration in the content of the metal, while it also prevents the absorption of sulphur and other injurious elements to a great extent. Rapid melting also means hot fluid metal as a rule, and everyone understands what advantages accrue from this in the general iron-casting shop. To some extent also there is an economy of fuel with rapid work, and a good fireman will regulate both blast and charging to secure the best results, always provided that he knows his business, and has provision made for his requirements. At the same time if every laborer is not able to make up a furnace who can run it to the best advantage, and for this reason a skilled melter or cupola man is necessary, even if comparatively high wages have to be paid, as the matter of ten or twelve shillings per week on wages will usually be recovered from economies secured by more efficient working. It is not the mere wages paid, but the product of such wages which is the real point for consideration. If we employ four men at 3 shillings per day to do certain work, we have an outlay of 12 shillings; but if we get two men at 5 shillings 6 pence per day for the same output of work, we pay only 11 shillings per day, and save on tools, supervision, and other items of cost, which indirectly affect output.

The combustion of fuel—carbon—depends on the amount of oxygen supplied, and it is a fair thing to say that for the complete combustion of carbon to carbonic acid, to each pound of carbon 2.66 pounds of oxygen must be supplied. Now as for all purposes of practical working it may be taken that ordinary air is composed of 23 per cent oxygen and 77 per cent nitrogen, we find that the weight of air containing 1 pound of oxygen is 4.35 pounds ($100 \div 23 = 4.35$). Therefore if we multiply 4.35 by 2.66 we get 11.57, or, say, 12 pounds of air as being necessary to provide air for the combustion of 1 pound of carbon, or for general purposes 1 pound of furnace coke of good quality, as, in addition to the carbon, coke contains other elements which absorb oxygen during combustion. At the same time, there are other things than coke to be taken into consideration, and from two to three times the amount of air necessary for the mere combustion of the fuel is necessary; but of this later.

Taking the question of the weight of air versus its bulk, it may be taken that the air from the fan is sent into the cupola at somewhere between 42 and 72 degrees F., or, say, for forming our calculations we may take an average as being 62 degrees F., at which temperature a cubic foot of air weighs 518 grains; and to get 12 pounds of air we find that 162.1776 cubic feet of air must be passed into the cupola for each pound of coke consumed ($84{,}000 \div 518 = 162.1776$). And assuming that we use 8 pounds of coke per hundredweight of iron, and melt 40 hundredweight per hour, we get $162.1776 \times 8 \times 40 = 51{,}896.832$, or, say, 51,897 cubic feet of air necessary to convert the coke into carbonic acid, etc., for each hour we work. Rather less will be required at lower, and more at higher, temperatures, but this is not a matter which should cause difficulty.

As, however, we have slip in the furnace, and as we also must have pressure to secure more rapidity of combustion than is required for the mere conversion of the fuel into its gaseous and other products, at least double the quantity of air is required to that stated, and the fan should deliver quite 105,000 cubic feet of air per hour into the cupola to secure the reduction of two tons of iron to a fluid state, or say, 1750 cubic feet of air per minute, and this should be delivered at a pressure of from 12 to 14 inches or a trifle more. The fan should in every case be capable of producing a greater output than that required, and the longer distance the air has to be carried, or the more bends or curves there are in the pipes, the more powerful must be the fan, and larger the pipes. Thus, on a short straight run, the writer would have a No. 4 Sturtevant "high-pressure" fan running at

from 3000 to 3500 revolutions per minute for a 20 to 22 inch cupola, inside, but on a long or crooked run of pipes a No. 5 or 6 fan would be used, owing to the friction to be overcome. In regard to pressure fans, for all practical purposes it may be taken that the power absorbed is dependent on the quantity of air forced through the charge, and it is not perhaps quite an easy calculation. It must be at all times remembered, however, that an excess of power is always desirable, otherwise you might find difficulty in cases where you want more air owing to a larger fuel consumption, caused by using a more refractory iron.

Coming to the pipes conveying air to furnaces of any kind, ample size and freedom from sharp bends or angles should be the rule, while they should be as direct as possible. You can take air under pressure from a fan for long distances if the pipes are large enough and there are no angles or acute bends en route, but so soon as you get these, trouble commences. Iron pipes are the best for air carriers, but glazed earthenware sanitary pipes are nearly as good when properly jointed with cement and kept clean inside. Sanitary pipes do not corrode or oxidize, and for underground work will be found preferable to iron in many cases, and their being in comparatively short lengths is an advantage. Besides this, proper junctions are made, suitable alike for the ready distribution of water and air. If you prepare a proper plan of your proposed arrangement of pipes—as you should do,—little difficulty should occur. In all cases the carrying pipes should be larger than the fan outlet, and if the air has to be carried any distance, the increase in diameter may be as much as 3 inches, to overcome the friction which occurs. As a rule, however, the friction is most felt with the smaller pipes, as a 6-inch pipe has an internal circumference of 18.84 inches, with an area of 28.2744 inches, while a 12-inch pipe has an internal circumference of 37.69 inches and an area of 113.097 inches, or four times the capacity, with only twice the frictional surface. If we take one-half inch as being dead through friction, in the 6-inch pipe we get a live area of 23.7583 inches, while in the 12-inch pipe we get a live area of 103.869 inches, a loss of roughly 4½ inches in the first instance, and 9¼ inches in the second, giving losses in effective area of roughly 16 and 8 per cent respectively.

When you get to the cupola, the form of belt tuyeres, and other things affect the admission of air to the charge very greatly, and usually these things are not alterable, each furnace having to be separately dealt with on its merits. It must, however, be kept in mind that the area of the belt should be at least as large as that of the carrying pipes, or you will not get the air the fan propels, as eddies always occur where the air passes from the belt to the tuyeres. Most modern cupolas are arranged to take the blast on lines laid down by the makers, and for this reason all that can be done is to carry the air in sufficient volume and at sufficient pressure to the furnace attachment, whatever this may be, and usually all that is left is to arrange the fan and pipes in the most efficient manner for the purpose.

Probably a large amount of air is wasted by inefficient charging; but this is a point which chiefly affects the supply of air as regards quantity, and it is largely for this that the extra allowance of air supply is required. If you have not the supply of air sufficient to allow for that amount of slip which is sure to occur at times, you are sure to get sluggish, dull metal, while on the other hand if you drive too much air through the melted metal in the well of the cupola, you will burn out the carbon. For this reason all quick-melting cupolas should be frequently tapped, or otherwise should have a receiver attached. Where large weights of metal are required, they should be secured by having a cupola of sufficient size, rather than storing large bodies of molten metal in a small cupola, as nothing is gained by this latter method.

When we can obtain oxygen at a sufficiently low price, it will be possible to melt metal without blast, as then a very slight pressure will cause it to enter the fuel and sustain perfect combustion with intense heat. The time has not yet arrived, though.—[Walter J. May, in *Mechanical World*.

The Metallurgical Engineer in the Foundry.*

BY HENRY SOUTHER.

The name is against him. It looks as though he would be a theoretical crank, that his ideas would be based on theories only and conflict with common practice. This is quite possible. It is certain to be so unless his training has been a good one; unless he has step by step learned the actual details of foundry work. But if he has begun by getting into actual contact with every practical detail and has had a theoretical education, such as has instilled into

*From paper read at the Milwaukee meeting of the American Foundrymen's Association.

his mind the fundamental principles underlying all metallurgical processes; then by bringing these two educations to bear together he should prove a valuable assistant and adviser to the man who has not had these combined advantages.

Some foundrymen and managers feel that they may acquire this special knowledge and save the expense of expert service, and while a few do so they are the exception and not the rule, and even so it is my opinion that some important details may be overlooked by them and that a manager's time may be better spent. Some think they know it all and try it only to find that "a little knowledge is a dangerous thing" and then go back to old methods.

There is nothing more true than that it is easier to keep out of trouble than get out of it. A little money spent systematically for the services of a metallurgical engineer (not a chemist) pure and simple, may save great sums. It is very much in the nature of an insurance against loss. Conditions may seem so favorable for months at a time; materials may be received of such uniform and satisfactory quality that money spent for expert services will appear to be wasted and therefore the plan discontinued. Then of a sudden there may come shipments of coke or iron, which had they entered the cupola would have ruined at least one day's product before discovery, and the loss would have paid an expert for some time.

I have excepted the chemist from this argument and will show my reason for so doing. A good chemist may be able to determine the amounts of the various elements in irons or fuels to the third decimal to the minimum limit of chemical error. He may be quick and do a large number of determinations per day. But of what use are results without practical interpretation and application? A chemist may become the best kind of a metallurgist, but only by personal contact with metallurgical operations in every detail and in several branches. A good share of common sense is a most valuable and necessary adjunct.

A metallurgist need not be a chemist but he must know how to use a chemist and the results obtained by the chemist. The chemist is an absolute necessity to the metallurgist. The steel industry is the most marked example of an industry thriving under the care of expert metallurgists assisted by chemists. The two are rarely united in one person, each being busy in his own field.

Blast furnace practice, from being a hazardous uncertain process full of difficulties, became a process of certainty with the advent of technical knowledge. All because the furnaceman with his secrets gave way to the metallurgist and his open and exact methods, subject to the inspection of all concerned. Then of course these same methods grew with the then infant steel industry and became an essential part of the industry. That which is common practice now would not be possible at all without the chemist to analyze under the direction of the metallurgist and with his interpretation of results.

Foundry and blast furnace practice is complicated in its reactions as compared with steel and really needs expert knowledge as much if not more than steel making, providing of course results anywhere near uniform are desired. Yet it is only of late that any expert knowledge has entered foundry practice of the general jobbing or manufacturing trade. It had been used as an accepted necessity by all foundries owned by the steel works or closely associated with them for many years.

The argument has been that the small foundry could not afford the services of a metallurgist because his output did not warrant the outlay. Or the small producer has said it did not matter, his product was so small that it was not a necessity. As though what little he made might not be more important as far as quality is concerned than the crude product of a large concern.

It is no longer necessary for a foundry, large or small, to employ the exclusive services of a metallurgist. One may be found in nearly all the large manufacturing centers of the east or west who is at the service of the general foundry trade on very reasonable terms. As a rule these experts have their own chemical and physical laboratories; a necessity in nearly every problem under their investigation.

One without the other is helpless. As a matter of fact the chemist without practical training and experience has blocked and retarded the advance of expert knowledge into the foundry trade more than any other element.

He has industriously spent time and money analyzing for elements not in any way entering the problem in hand and when obtained proving of interest but not of commercial value. A good metallurgical engineer ought to secure better results than a first-class chemist could obtain, because of his practical training.

Every analysis the metallurgist should ask for ought to count in getting at results. What

a lot of good time and acid is wasted in determining the amount of graphitic carbon in pig iron for cupola work. The total carbon is the only vital carbon result worth consideration in connection with iron to be used for melting.

The amount of graphite is a measure of the time of cooling of the iron in which it exists. It depends on the initial heat of the molten iron; on the character of the mold in which it was cast; whether dry sand, wet sand or an iron mold, and on the volume of the casting. It may be varied at will by varied speeds of cooling and to conclude, all carbon returns to the same conditions when melted, regardless of its condition when solid.

It is instructive in a finished product because it so strongly influences the physical characteristics of cast iron but valueless in pig iron for melting purposes.

I mention this as I know it to be one of the most marked examples of wasted effort in foundry chemistry. The iron agents dote on graphitic carbon. They would rather talk graphitic carbon to a prospective purchaser, and thereby throw glamour and mystery over their iron, than eat.

This is only one example of misdirected effort and by this and many others the chemist, pure and simple, has caused many foundrymen to condemn all chemical work and set all expert knowledge down as useless.

Another practice is having the same effect. The foundry manager who buys chemical analyses at a few cents each soon accumulates sheets of them; most are useless because he has not the necessary knowledge of metallurgy to get much out of them. Then he buys books on cupola practice, some of them good, others inaccurate and misleading, at any rate contradictory. He is stuck and finally concludes the experts do not know anything anyway. Why? Because he has not employed a good one and because all that is printed in books about foundry practice is not gospel truth.

One writter advocates physical tests only, another chemical tests only, another no tests at all and so on. As a matter of fact each kind of test is most instructive in its own particular field and an intelligent use of all kinds is the best practice. The thoroughly practical metallurgical engineer is he who uses one or all as the case demands and thereby obtains the best results.

It has been thought that the small foundry has less use for expert knowledge than the large one. I find the contrary to be true. Of the two the small producer is liable to experience the greater irregularities of product. The large buyer purchases iron in large shipments and either analyzes every one and keeps them separate, thereby using them most intelligently, or he throws them into large piles. The latter being the case, then he uses from these large heaps not in the same order in which it was piled but instead in a different order, consequently getting an average from the pile for a day's melt.

This is like the making and eating of a layer cake. It is built up in horizontal and specialized layers and is eaten in vertical layers, each piece a good average of the whole.

In case there have been wide variations in the chemical character of the various shipments they will be hidden in the average, which will be about normal, certainly not bad enough to cause serious trouble at any time unless there has been a succession of bad shipments, the badness being all of one kind. This is not likely to occur and the large user is fairly safe. On the other hand the small buyer may have only a few car loads of iron in the yard and possibly these are of one kind, and that kind way up in sulphur or bad in some other respect.

It is plain that the small consumer needs more help in proportion to his tonnage than the large consumer. His cost charge for expert service will be greater per ton, all other things being equal, but not heavy in consideration of possible benefits and savings.

Assuming an engineer to look after metallurgical matters is employed, then to get the greatest benefit, the work must be systematized. Regular tests of castings must be made often, if changes are made in the mixture, and frequently in the event of the slightest irregularity. Even in the case of very smooth running, tests should be made weekly so that a record may be preserved.

Some one person at the works must make it part of his duty to follow up the correspondence with the metallurgical engineer and to report to the purchasing agent any invoice of iron that is not as good as ordered. The latter may then reject the iron if it is too bad to use at all or to offer to take it at a reduced price commensurate with its real value, if it is possible to use it somewhere. On the other hand if the iron is better than ordered (which often happens) then it may be laid aside to be used as an offset to some bad shipment when the occasion arises. The same remarks ap-

ply to fuel and all other materials purchased.

It is certain that some one person must give these matters attention to gain the best results and also that much money, over and above the charges of the engineer and chemist, will be saved. But like any system, such as cost or inventory, if it is not followed up, not only will there be no saving but there will be the loss of the original expense of introducing it.

There is a feeling among many foundrymen that the employment of a Metallurgical Engineer will result in great friction with the iron dealers, because of the probable fussy demands of the engineer. I want to state an exactly opposite view. The intelligent engineer knows exactly what to ask for and exactly what may be had in the market at ordinary prices. He puts before his employer the simplest possible specification that will bring him the kind of pig iron he wants. The limits may be very wide and still give uniform castings for a product with intelligent mixing of several irons. When such an iron is received by the foundry and is found to be within the reasonable limits specified, then there can be no more question between buyer and seller. The responsibility rests on the engineer who specified it.

Hand Ramming and Power Ramming Molding Machines.

The works with which I am connected (the Tabor Mfg. Co.) build both hand and power ramming molding machines and are as glad to build one kind of machine as another. It would, therefore, seem that I can speak without prejudice on the much disputed question of the relative merits of hand and power ramming in machine molding.

It was stated in the discussion of this subject at the Milwaukee meeting of the American Foundrymen's Association that the economy of hand ramming increases as the size diminishes. This is true, so far as size affects portability; and yet there are some very large jobs of molding on which it is self-evident that, whether they are done by machine or hand methods, the ramming must, for the present at all events, be done by hand. The advantages of the hand ramming machine are:

First, cheap first cost.

Second, portability.

Third, no power required if the expense of stripping plates is undertaken, in which case, however, the first advantage disappears.

Therefore, portability seems to remain the main advantage of the small machine, hand rammed. Yet it is a singular fact, which needs no demonstration further than a trip through our large malleable foundries where squeezers are at work, that hand ramming machines are not by any means universally made portable, even when they might easily be.

There is one situation where the hand ramming machine is indispensable, if power is not available to operate power-jarring machines, and that is where the work is so deep that almost all the mold has to be rammed by hand. In point of cheapness, the hand ramming machine has a marked advantage as its size increases, as the cost of power ramming machines increases enormously with the area and depth of the flask.

It should be self-evident that, so far as the molding operation alone is concerned, the machine which, at a single blow, rams one and sometimes both parts of a mold in an instant, saves not only the time in the operation, but the actual manual labor required to compact the sand. And the ideally perfect machine molding is had when the mountain comes to Mahomet by means of a sand conveyor supplying a fixed power machine, the molds from which are transported by a continuous runway, the operator not moving from his tracks. We now have a machine just started to which a conveyor supplies the sand, and from which the molds, weighing 5,000 lbs. apiece, are carried away by a traveling crane; and on this machine four laborers using separate facing, shoveled from the heap, and tucking two deep edges by hand, deliver molds measuring 20 inches x 79 inches, 18 inches deep, at the rate of between five and six an hour, in which a molder and helper set fifteen cores, finishing the molds with lead; and, if the work were simpler, this output would be very much increased, as indeed it probably will be, as it stands, when the men become more proficient.

E. H. MUMFORD.

The Recovery of Copper From Pickle or Dipping Solutions.

There are many instances where the copper present in pickle or dipping solutions may be readily recovered and become a source of more or less revenue to the manufacturer. The following method is one which is not only readily performed, but practically costs nothing but the labor involved:

Put the solution containing the copper in any convenient receptacle—tanks, barrels, or

vats. Place a quantity of wrought iron scrap in it and allow to remain for a day or so. The time depends upon the amount of iron which is used and the temperature of the solution. The more iron that is used, the more quickly the copper is precipitated. A warm solution also hastens the process. The copper is precipitated by the iron as a granular deposit, which falls to the bottom of the tank if the iron is shaken from time to time. When all the copper is removed from the solution, the iron will not show any indications of copper deposit. The liquid may then be siphoned off and the copper removed from the bottom. Having a fixed market value, the copper may be readily sold.

The theory of the process is simple—the iron takes the place of the copper and goes into the solution. The copper replaces the iron and separates out in the metallic state. Such metals as lead, zinc or nickel remain in the solution and are not separated out by the iron.

Many persons have not had good success with this method on account of using cast iron instead of wrought or soft steel. All cast iron contains a large amount of carbon, which interferes with the precipitation of the copper. Either soft steel or wrought iron should be used; preferably the latter. Wrought iron barrel hoops answer well, and are exceedingly cheap. They also present a large surface. Galvanized sheet clippings are also excellent. It is quite obvious that the iron should be free from grease.—*The Metal Industry.*

Two Phosphor Bronze Formulas.

Here are a couple of formulas for Phosphor Bronze, together with tests each stood. Notice the difference the variation in phosphorus gives:

Copper, 89.5 per cent; tin, 10.0 per cent; phosphorus, 0.5 per cent.

Diameter bar, 1.115 inch.

Broke at 36,000 pounds.

Tensile strength, 36,890 pounds per square inch.

Elongation in 8 inches, 9 per cent.

Copper, 89.9 per cent; tin, 10.0 per cent; phosphorus, 0.1 per cent.

Diameter bar, 1.111 inch.

Broke at 39,200 pounds.

Tensile strength, 40,400 pounds per square inch.

Elongation in 8 inches, 25 per cent.

Aluminum Castings to Resist Pressure.

A manufacturer who has been experimenting with aluminum vessels to resist pressure complains in the *Aluminum World* that when water was allowed to stand in the vessel for a length of time there would arise a chemical action, seemingly eating away the metal and apparently decomposing the aluminum. In another form the metal was found much more porous than had been anticipated and unable to resist water pressure of any force.

The difficulty found in the action of the water on the aluminum is mainly caused by the alloy which the material contains. While pure aluminum is slightly corroded by water after standing a long time, its alloys which are now generally used for sand casting and containing a large percentage of zinc and copper, are acted upon very readily by water. To get the best results for this purpose the aluminum should contain as little alloy as possible. Of course pure aluminum is not suited for castings of this kind on account of its softness, and for this reason a small amount of alloy should be used. Zinc must not be used in such alloys, and one consisting of aluminum 94 per cent. and copper 6 per cent. is the most satisfactory for the purpose. Even this alloy will, in the course of time, become slightly corroded by the water, but in much less degree than the alloys which contain zinc. When it is known that some of the aluminum alloys on the market contain between 30 per cent. and 40 per cent. of zinc, the reason for the abnormal corrosion may be readily understood.

As regards the porosity of aluminum castings it may be said that aluminum and its alloys in the form of sand castings are not suited for the purpose of resisting pressure. While the castings may not, to the naked eye, be porous, yet when pressure is applied they almost invariably "sweat." Changing the method of gating, and that of pouring; keeping the temperature of the metal as low as possible; not allowing the metal to "soak" in the fire, together with many other precautions in manipulation will, to a certain degree, obviate this difficulty, but not to any great extent.

The plant of the Lalance-Grosjean Mfg. Co., Harrisburg, Pa., is to be enlarged by the addition to the foundry of a 60-foot building and the erection of a new pattern shop.

A Pattern Tracer.

To keep track of the patterns entering its foundry, the Braddock Machine & Mfg. Co., of Braddock, Pa., employ the form of card shown in the attached illustration. The back of same is so arranged that it may serve as a record of the receipt and delivery of the pattern, should this be transferred a number of times from the foundry to the owner or to other parties.

Braddock Machine and Manufacturing Company.

Class,		No.
For		No. of Core Boxes,
Condition of Pattern when received,		
Weight of Casting,		Price,
No. Required,		
Ship Pattern to		
Remarks.		

A PATTERN TRACER.

Special Molding Machines.

Most foundries making any kind of castings in quantities are now becoming well acquainted with the molding machine as an aid in reducing labor costs. There is no doubt but that the question of installing larger machines to deal with the main or heavier castings is well worthy of investigation.

On account of the greater price of the larger size machines many founders are kept from

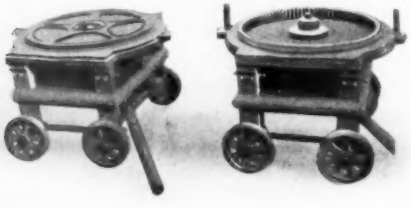


FIG. 1.

purchasing these, although they have a medium number of heavy castings to make which would require several different sized machines to cover their requirements. Such is especially the case with several manufacturers of implements, who make seasonable goods, commencing the year with a special machine and after two or three months substituting another one to meet market conditions, thus dealing with an entirely different machine at certain parts of the year. To meet such a demand the molding machine shown in the attached illustration was designed. The internal gear which is shown mounted on the machine is a casting

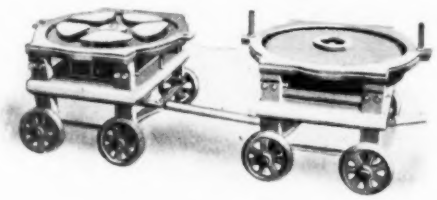


FIG. 2.

which requires to be perfect in every way, and the excellent results obtained, together with the enormous reduction in the cost of making these castings, are sufficient indications of its success.

In the ordinary course of business two months' work would finish the order for this casting and therefore the machine would be idle for ten out of twelve months. In designing it, however, this had been taken into consideration, and the machine built so that it would take in other castings wanted throughout the year. Therefore whenever one order was completed the patterns with their stools and stripping plates were carefully removed and patterns for other castings attached to the machine. The various parts dealing with each

pattern are carefully lettered to prevent confusion and delay when these are to be remounted, and in emergencies several patterns

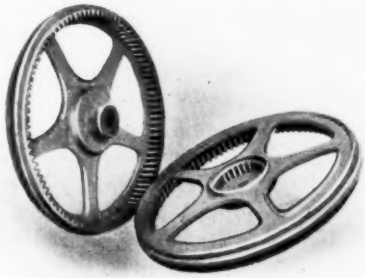


FIG. 3.

have been worked and castings secured therefrom on the same machine in a single day.

GEO. BUCHANAN.

Deaths.

E. J. Aulls, a well known foundryman at Bath, N. Y., was drowned in Lake Keuka, August 4.

Albert Sivyer, aged 19, the second son of Frederick W. Sivyer, president of the Northwestern Malleable Iron Co., of Milwaukee, was drowned at Nantucket, Mass., Saturday, Aug. 22, while sailing with some companions.

Wm. Dowling, a well known foundryman of Logansport, Ind., died July 23, after a long illness, aged 68 years.

Fires.

The foundry known as the Ark, one of the landmarks of Algona, Pa., was partially destroyed by fire recently. The plant will be rebuilt.

Fire on the morning of August 6 in the machine shop of the Morgan Iron Works, East Tenth street, New York, did damage estimated at $25,000 to the building and its machinery.

Fire at St. Clair, near Philadelphia, Pa., August 4, destroyed the tool shop, blacksmith shop and other buildings of the St. Clair Coal Co., Scranton, Wis.

Fire damaged the foundry of the American Woodenware Machine Co., Green Bay, Wis., August 5.

The plant of the White-Warner Co., Taunton, Mass., was damaged by fire to the extent of $50,000 August 2. The fire broke out in the foundry.

Fire recently destroyed W. McNicoll's machine shop and foundry, Mt. Vernon, Wash. Loss, $1,000; no insurance.

The foundry and machine shop, of R. Stokes, 30th and Chestnut streets, Philadelphia, were damaged by fire to the extent of $1,100 July 30.

The plant of the Port Washington Foundry Co., Port Washington, Wis., was damaged by fire to the extent of $10,000, fully insured, July 25.

Personals.

William Hanson, for many years in charge of the foundry of the Pennsylvania Iron Works, Philadelphia, has accepted a similar position with the Canada Foundry Co., Toronto, Ont.

John Loder, one of the best known and most popular iron molders in Pittsburg and a member of the executive board of the Iron Molders' Union, has become a representative of the S. Obermayer Co. His territory is about Pittsburg and Allegheny City.

David Townsend, mechanical and consulting engineer, of Philadelphia, has severed his connection with the Eddystone Foundry & Machine Co., formerly the Gruson Iron Works, of Eddystone, Pa., and will hereafter devote his whole time to the designing and equipment of industrial plants, in which he has had 25 years' experience.

The reference to Paul R. Ramp in the last issue of THE FOUNDRY was in error. Mr. Ramp is assistant general superintendent of the foundries of the American Brake Shoe & Foundry, as he has been for some time past.

W. H. Van Sickel, lately manager of the New York office of the Underfeed Stoker Co. of America, has accepted a position as superintendent of the Thos. H. Dallett Co., which is making extensive improvements to its plant at Philadelphia for the manufacture of pneumatic tools and portable drills.

Among the Foundries.

The Fort Scott Mfg. Co., Fort Scott, Kansas, recently organized with a capital of $50,000, to engage in foundry and machine work, has taken over the Kite foundry. The following are the officers: C. C. Crain, president; J. H. Mead, vice president; J. H. Prichard, secretary; L. H. Stout, treasurer and M. T. Kite, superintendent. It is the purpose of the company to double the capacity of the plant. They will manufacture the Kite gaso-

line engine, the Fort Scott feed mill, and do a general foundry and machine shop business.

Several eastern capitalists, headed by Benjamin Guggenheim, of New York, have purchased a large amount of stock in the Holthoff Machinery Co., whose plant is located at Cudahy, near Milwaukee.

W. F. McCrea, Beaver Falls, Mass., has decided to move his foundry and machine shop from Beaver Falls to Sharon. It will be enlarged and stoves will be manufactured.

The molders of the Home Stove Co., Indianapolis, have been granted an advance of 10 per cent and have returned to work. A similar concession has been granted to its employes by the Indianapolis Foundry Co.

Langmaid & Morrill, Bath, Me., will build a machine shop and foundry.

The new Zanesville and Western shops at Fultonham, O., have been completed. They include a roundhouse, machine shops, blacksmith shops, etc. A new 40-room hotel for the trainmen has also been erected.

The new foundry building and machine shop of the Nixon Mining Drill Co., Chattanooga, Tenn., which has been in the course of erection for several months, will be completed in two weeks.

The drafting department of the Lloyd Booth plant of the United Engineering & Foundry Co., will discontinue September 1st and move to Pittsburg. All work in connection with the Youngstown plant will hereafter be done in the offices at Pittsburg.

The Southern Foundry Machine Co., Knoxville, Tenn., will rebuild its plant recently destroyed by fire as soon as the insurance is adjusted. During the few years of its existence the company has built up a large business in the south.

Work of grading for the new plant of the Pawling & Harnischfeger Co., Milwaukee, Wis., has been commenced. The main building will be 350x400 feet and the foundry will be 280x100 feet. The office will be three stories 60x100 feet. All of the buildings will be constructed of iron and brick, fireproof, and equipped with the most modern appliances for the manufacture of electric cranes.

The Vulcan Iron Works Co., Winnipeg, Manitoba, is erecting a foundry 100x198 feet, which promises to be the best equipped of its kind in western Canada, when completed. It is said that the new building will be ready for use by the end of September.

The National Steel Foundry Co., New Haven, Conn., has given out the contract for its new foundry to the McClintic & Marshall Construction Co. The building is to be 165x411 feet, of steel construction, and with two wings each 35x100 feet.

The Reeves Engine Co., Trenton, N. J., will build a foundry, one-story brick, 92x127 feet, equipped with all modern apparatus.

The West Allis Malleable Iron & Chain Belt Co. is making important improvements. The foundry of the plant is to be made 208 feet longer, and the chain belt department will be enlarged. About 200 men will be employed.

The Anderson Machine & Foundry Co., Anderson, S. C., has increased its capital from $10,000 to $20,000.

W. J. Dodge and associates of Gadsden, Ala., have leased the Caldwell Foundry at Fort Payne, Ala., and will organize the company at $25,000 to operate it. Repairs will be made and additional machinery installed.

A foundry, pipe manufacturing and core making establishment have been added to the American Sanitary Works, Elizabeth, N. J.

The Beggs Pipe & Foundry Co., Birmingham, Ala., will erect a one-story brick building to be used as a foundry.

Ground has been broken on the site of the new buildings that are to be erected for the T. H. Buckley Car Mfg. Co., Worcester, Mass. When finished the concern will employ 300 men. The company is capitalized at $250,000.

Plans for a five-story smith and pattern shop and storage room for the Southwark Foundry & Machine Co., Philadelphia, have been prepared. The walls will be mainly of expanded metal and cement. The building will be 158x99.

The Southern Car & Foundry Co., was declared bankrupt at Trenton, N. J., July 28. That was the return day on the bankruptcy proceedings instituted by the Standard Steel Car Co., of Pittsburg, and no defense having been put in, the bankruptcy order was entered.

The Oscar Barnett Foundry Co., Newark, N. J., has declared a dividend of 3 per cent. Last year the company paid over 16 per cent on its capital of $50,000, and this year it expects to make still larger returns.

The J. H. Gillon Machine Co., Waycross, Ga., has begun operations in its new foundry which is about three times as large as the foundry building formerly occupied.

The Red Wing Boat Mfg. Co., Minneapolis, Minn., has been incorporated with a capital of $50,000 to engage in the manufacture of boats and engines and to conduct in connection therewith a foundry and machine shop.

G. D. Gingrich and H. R. Willi have leased the Lehman plant at Williamsport, Pa., and incorporated a business under the name of the National Foundry & Supply Co. The products will be chiefly a full line of transmission machinery. The plant consists of a group of buildings, including a foundry, pattern shop, machine shop, etc., the whole comprising of 30,000 square feet of floor space.

The J. H. Gillon Machine Co., Waycross, Ga., has moved into its new foundry, and the first cast was taken off a few days ago. The new foundry is about four times as large as the old one.

The Flum Foundry Co., one of the new industries of Hamilton, O., was put in operation a few days ago. It will employ 50 men.

W. J. Dodge and associates, Gadsden, Ala., have leased the old Caldwell Foundry at Fort Payne, Ala., and will shortly form a $25,000 stock company to operate the plant. A general foundry business will be done and from 50 to 60 men will be employed.

The Hyle Steel Tool Co., Syracuse, N. Y., converts steel from malleable iron, in other words, makes casts of malleable iron and converts them into steel tools. The company has been manufacturing stocks and dies for plumbers and steam fitters for a year and a half, and has been giving good satisfaction. The company is enlarging its plant to some extent. The plans and specifications are in the hands of the contractors. Specifications are being made for both steam and electric power. The company will use 12 grinding machines, 10 polishers, and will equip a large foundry. In the present plant there are 2 turret lathes, 4 grinders, and 2 milling machines. As soon as the plant is completed the company expects to make axes, hammers, hatchets, wrenches, tube expanders and other kinds of steel tools.

The Battle Creek Iron Works Co., Ltd., Battle Creek, Mich., has secured the contract for furnishing all the castings for the Grand Trunk Western Railway Co. The Railway Company will require about 150 tons of castings each month.

The Denver Steel Casting Co., Denver, Col., recently incorporated has absorbed the Colorado Steel Casting Co., which was organized some time ago. The latter company owns all the rights of the Atlas Car Coupling Co. The concern will at once begin work on a new plant in Denver, and it is expected that it will ultimately employ several hundred men.

The new Lavelle Foundry Co., Anderson, Ind., started operations a few days ago. The plant is well equipped for handing a general line of foundry work.

The Wrought Iron Range Co., one of the largest concerns of its kind in the west, has decided to move its entire plant in St. Louis to East St. Louis, Ill. The main reasons for change of location are given as a failure of the Terminal Association to promptly handle goods between St. Louis and East St. Louis, lack of terminals on the Missouri side of the river, bridge charges which amount to $8,000 a year and the increase of the value of property on which the plant is now located. The new plant will be built at an estimated cost of $1,500,000. The company is one of the pioneer manufacturing plants of St. Louis, which was founded in 1864, and its present officers are: H. H. Culver, president; W. L. Culver, vice president; Edwin R. Culver, treasurer, and B. B. Culver, secretary.

Henry A. Burtt, commissioner, has sold the foundry of the George S. Anderson & Bros. Co. of Jeffersonville, Ind., to G. S. Anderson & Co., for $2,300.

The Peninsular Stove Co., of Detroit, having a capital of $2,000,000, have been incorporated. The company has been in business for many years, but was not incorporated, until recently.

The stockholders of the Richford Foundry Co., Richford, Vt., have declared their semi-annual dividend of 5 per cent.

The Manitoba Iron Works, Winnipeg, Manitoba, made its first castings a few days ago. The company started work with a good list of orders and its prospects are excellent.

As a result of the final meeting of the citizens of Findlay, O., and the energetic canvass by the representative business men of the city it is announced that the United States Foundry will soon commence operations in that city.

The contract for the grading of the grounds for the new steel plant of the Baldt Steel Co., New Castle, Del., has been awarded, as is also the contract for the grading for the new plant of the Brylgon Steel Co., which will join that of the Baldt Co. On the grounds of the Baldt Co., there will be erected 3 buildings each 300

x65 feet. They will be used in the making of steel castings. On the Brylgon property there will be one building, which will measure 600 feet by 65 feet.

The Niles Car & Mfg. Co., Niles, O., has completed its new blacksmith shop, which is 80x126 feet, equipped with the latest machinery.

The Pittsburg Foundry Co., Denver, Col., has been granted a permit to erect an addition. This is contrary to wishes of residents near the foundry, who threaten to take the matter into court and have the plant condemned as a nuisance. The city attorney has ruled in favor of the company.

The contract for the Walworth Mfg. Co.'s brick and stone foundry, South Boston, has been let. It will be a $75,000 structure.

The town of North Butler about 1½ miles north of Butler, Pa., is about to be established. It will be the location of a large plant to be erected by the Butler Foundry & Machine Co. The company is composed of Butler and Pittsburg capitalists. Gray iron, malleable and steel castings, a new boltless rail and machinery will be manufactured. The company will employ about 400 men.

The Terrell Iron Foundry, Terrell, Texas, recently destroyed by fire, has been rebuilt, and made its first casting a few days ago.

The Denver Steel Casting Co., Denver, Col., has been incorporated with a capital of $500,000, and will soon begin the erection of a large plant.

The Crescent Foundry Co., Wilmington, Del., will erect a new building 100x45 feet, thereby increasing the size of the plant about one-third.

The U. S. Machinery Co., Beverly, Mass., has awarded the contract for the building of its new plant. The building will consist of an administration building, storage building, a foundry and blacksmith shop.

The Sizer Forge Co., Buffalo, N. Y., will erect a new addition of steel construction, 96 x100 feet. The equipment will include a 12-ton steam hammer and a 30-ton electric traveling crane, purchased from the Morgan Engineering Co., Alliance, O.

The Titusville Forge Co., Titusville, Pa., is enlarging its blacksmith shop to 50x100 feet, and is adding a large steam hammer, several jib cranes and other equipment to the foundry and machine shop.

The Northwestern Foundrymen's Association at its recent meeting at Marinette, Wis., elected the following officers: President, L. L. Prescott, of the D. Clint Prescott Co., Marinette and Menominee,; vice president, J. F. Kern, of the Lake Shore Engine Works, Marquette; secretary, and treasurer, Geo. Royce, of the Portage Lake Foundry & Machine Shops, Hancock, Mich.

The Keystone Foundry & Machine Co., Lebanon, Pa., will erect a large building for nickel plating machine parts and for the storage of bicycles manufactured by the company.

President Hutchinson, of the Mexican Car & Foundry Co., of Mexico, has been notified that the government has approved all the plans presented by the company for proposed buildings and machinery. Active work will be commenced at once, and $1,000,000 will be expended.

At a recent meeting of the directors of the Girard Foundry & Machine Co., Youngstown, it was decided to make extensive additions to the plant. The following officers were elected: President, E. Hartzell; secretary and treasurer, G. M. Gundy; vice president, E. H. Lotze; manager, James Cooper; executive committee, D. B. Harris, W. J. Wallis and G. J. Jones.

The Giddings & Lewis Mfg. Co., Fond du Lac, Wis., is building an addition to its foundry.

The Ajax Metal Co., Richmond street, and Frankford avenue, Philadelphia, will erect a foundry 80x138 feet, at a cost of $23,000.

The Valley Iron Co., Bay City, Mich., has begun the construction of a new building 60x 74 feet, which will be used as a foundry.

The Portland Iron & Steel Co., Portland, Me., has commenced to rebuild the mill at Legonia, South Portland, destroyed by fire last August. The new buildings will be of fire proof construction, and will cover an area of about 50,000 square feet. W. C. Cutler, formerly of the Bethlehem Steel Co., has been secured as general manager. He expects to have the mills in operation in the fall of this year.

J. B. & J. M. Cornell, 29 E. 37th street, New York, will build a foundry at a cost of $2,500.

The Duplex Foundry Co.'s plant at Elyria, O., destroyed by fire recently, has been rebuilt and is now ready for business.

Construction work will be begun at once on the Mexican Car & Foundry Co.'s plant Mexico City, Mexico. About $500,000 will be expended.

The Salem Iron Works, of Winston-Salem, N. C., will be in the market shortly for a 10-ton cupola, a crane, blower, ladles, etc.

The Bridge City Construction Co., of Logansport, Ind., recently changed hands and will undertake a larger field of work in grey iron and other castings as well as a general machine business. The firm is desirous of making arrangements to manufacture any good article requiring foundry and machine shop conveniences. The shipment of the plant is being gradually increased in order to keep pace with requirements.

Providence Steel Casting Co. will be located in Providence, R. I., and will have exceptional railroad and tidewater facilities. The new building will be erected and specially equipped for the manufacture of steel castings. The main foundry structure will be 150 feet long by 118 feet wide. An electric traveling crane of 10-ton capacity and 50-foot span will be installed. All the machinery will be operated by independent electric motors. The power house will be equipped with a high pressure compound engine of 250 h. p. working at a 180 pound pressure and 230 revolutions per minute. The engine will be direct connected to an electric generator of 160 k. w. The output of the plan will be mainly small and medium weight castings made by the Tropenas converter process. The foundry will be first class in all its appointments and equipped with all necessary modern machinery to do work to the very best advantage. The officers of the company are: Darwin Almy, president; F. W. Hartwell, vice president; J. C. Hartwell, secretary; and E. M. Shaw, treasurer. Mr. Almy is of the Almy Water-tube Boiler Co. and F. W. Hartwell has been identified with the General Fire Extinguisher Co., both of Providence and Mr. Shaw has been connected with the steel casting business for a considerable time with headquarters at the Banigan Bldg., Providence, where the offices of the Providence Steel Casting Co. are located.

Notes From Various Sources.

The Scottdale, Pa., plant of the United States Cast Iron Pipe & Foundry Co., last week cast its first 60-inch pipe. Heretofore pipe of this size was cast at other foundries of this combination, but now that this department has been completed in the Scottdale plant, much of the large pipe for the Eastern trade will be cast at this plant.

The Richland Foundry Co., Belleville, Ill., is erecting a new plant to replace the foundry recently destroyed.

The Canadian Pacific Railway will erect a foundry 100x100 feet at Winnipeg, Can. Work will begin shortly.

Work on the foundry being erected by the Frank Patten Co., at Sycamore, Ill., is being pushed rapidly. About 120 men will be employed.

F. R. Peacock, will build a one-story brick brass foundry 120x60 feet at Norton, Pa.

Chicago Sand Rammer.

A sand rammer recently introduced by the Chicago Pneumatic Tool Co. is shown in the illustration. Its light weight and the fact that the machine can be operated by a man standing up saving the fatigue of bending over, are

two features to which attention is called. The diameter of the piston is 1 1-16 inch; the piston stroke, 7 inches; the number of blows per minute, 500, and the weight 17 pounds. The free air consumption at 80 pounds pressure is 30 cubic feet.

Alphabetical Index to Advertisers.

Adams, Co., The 16, 64
Addy, & Co., Matthew 54
Ajax Metal Co. 63
American Air Compressor Co. 50
American Blower Co. 21
American Glutrose Co. 71
Appraisal & Audit Co. of America 75
Arlington Mfg. Co. 60
Atlas Car & Mfg. Co. 53
Barbour-Stockwell Co. 68
Barnard & Leas Mfg. Co. 71
Barnett Foundry Co., Oscar 29
Berry Coal & Coke Co. 64
Blackwell Sons & Co., Geo. G. 56
Blair & Co., Reed F. 54
Blake Mfg. Co., Geo. F. 11
Brass Founders' Supply Co. 30, 67
Bristol Co. 56
Brown Specialty Machinery Co. 25
Bryan Vacuum Molding Machine Co. 57
Buffalo Foundry Suply Co. 74
Burdick & Sons 68
Byram & Co. 72
Carborundum Co. 66
Case Mfg. Co. 58
Cherry Valley Iron Co. 34
Chicago Flour Co. 74
Chicago Pneumatic Tool Co. 51
Clark, D. N. 28
Cleveland Crane & Car Co. 61
Christensen, N. A. 50
Church, S. R. 54, 75
Clark Cast Steel Cement Co. 26
Clayton Air Compressor Works 50
Coburn Trolley Track Mfg. Co. 38
Collis Pattern Works 53
Columbus Iron & Steel Co. 54
Connersville Blower Co. ..... Back Cover
Cornell, J. B. & J. M. 59
Cowles Electric S. & A. Co. ..... Inside Back Cover
Curtis & Co. Mfg. Co. 4
Dalton, Nash & Co. 54
Dana & Co. 54
DeCamp Bros. & Yule Iron, Coal & Coke Co. 54
Dempwolf & Sons, E. A. 75
Delano Co., E. A. 17
Diamond Clamp & Flask Co. 70
Dimmick & Co., J. K. 55
Dings Electro-Magnetic Separator Co. 62
Dixon Crucible Co., Joseph 41
Domhoff & Joyce Co. 55
Elm City Engineering Co. 62
Etting, Edward J. 73
Fanner Mfg. Co. 65
Field-Evans Iron Co. 55
Fox Machine Co. 68
Garden City Sand Co. 72
Gautier & Co., J. H. 40
Gilmour, J. 39
Gobeille Pattern Co. 70
Goodrich & Co., F. A. 55
Gould & Eberhardt 67
Hanna Engineering Works 22
Hanson & Van Winkle Co. 73
Hawley Down Draft Furnace Co. 37
Herron & Bury Mfg. Co. 50
Hevl & Patterson 52
Hickman, Williams Co. 55
Hill & Griffith Co. 9
Hillman & Son, J. H. 55
Hunt Co., C. W. 52
Ingersoll-Sergeant Drill Co. 57
Keep, W. J. 69
Kelly & Co., T. P. 6
Kendall & Flick 57
Kittanning Iron & Steel Mfg. Co. 33
Laidlaw-Dunn-Gordon Co. 50
Leckrone Coke Co. 57
Lombard Co., N. A. 50
Mack & Co., Thos. A. 55
MacKellar's Sons Co., R. 70
Manning, Maxwell & Moore 59
Maris Bros. 58
Maurer & Son, Henry 75
Maywood Foundry & Machine Co. 13
McCormick Co., J. S. 7
McCullough-Dalzell Crucible Co. 42
McKeefrey & Co. 55
Metallurgical Laboratory 56
Midvale Mining & Mfg. Co. 54
Millett Core Oven Co. 32
Mills Oil Co. 66
Mohr, J. J. 55
Moyer, & Co. J. W. 62
Narragansett Machine Co. 75
Nash & Co., George 73
National Electric Co. 49
National Jeloluse Co. 74
New Era Mfg. Co. 62, 64
Niles-Bement-Pond Co. 58
Northern Electrical Mfg. Co. 49
Northern Engineering Works 60, 65
Obermaver Co., The S. ..... Front Cover and Page 1
Osborn Mfg. Co. 71
Otis Steel Co. 63
Pawling & Harnischfeger 61
Paxson Co., J. W. 2, 3
Pedrick & Ayer Co. 59
Penn Shovel Co. 53
Pettinos Bros. 71
Philadelphia Pneumatic Tool Co. 36
Phosphor Bronze Smelting Co. 63
Pickands, Brown & Co. 56
Pickands, Mather & Co. 56
Pilling & Crane 56
Pridmore, Henry E. 12
Railway Speed Recorder Co. 24
Rand Drill Co. 51
Republic Iron & Steel Co. 35
Ricketts & Banks 55
Ridkway & Son Co., Craig 23
Rogers, Brown & Co. 56, 76
Roots Co., P. H. & F. M. ..... Colored Insert
Schotte, Armin 75
Sellers & Co., Wm. 31
Shepard, Charles G. 56
Shuster Co., F. B. 67
Sly, W. W. 19
Smith Foundry Supply Co., J. D. 8
Smooth-On Mfg. Co. 27
Standard Sand & Foundry Supply Co. 70
Sterling Oil Co. 64
Stevens, F. B. 47, 56
Stevens & Blume 73
Stover Mfg. Co. 69
Stow Mfg. Co. 60
Sturtevant Co., B. F. 20
Superior Charcoal Iron Co. 56
Tabor Mfg. Co. 14, 15
Taylor, Wilson & Co. 18
Thomas Furnace Co. 56
Thompson, John J. 75
Vulcan Facing Co. 10
Waynesburg Pressed Steel Co. 57
Whitehead Bros. Co. 5
Whiting Foundry Equipment Co. 44
Winkley Co. 75
Yale & Towne Mfg. Co. 61

CONTENTS.

Trade Outlook 1
The Irrepressible Problem 1
Foundry Backwardness 3
Foundry Cost-Keeping 3
A Pattern Proposition 4
Milwaukee Fdy. Foremen's Ass'n 5
The Ideal Foreman 6
Making Pulley Without an Anchor 8
Cast Iron Notes 8
How They Do It in Manchester 9
Interstate Foundry Co. Plant 13
Finishing Deep Lifts 15
Foundry Management 17
Continuous Operation of Iron Foundry 18
Melting Ratio in Brass Foundries 20
Loss of Sulphur in Borings 23
American and English Foundry Tools 24
Foundry Responsibility 24
Little Known Molding Machine 25
Foundry Work at Worcester "Tech." 27
Novel Manufacturing Plant 30
Buying Pig Iron on Specification 31
Cupola Air Supply 34
Metallurgical Engineer in Foundry 35
Hand Ramming and Power Ramming 38
Recover of Copper 38
A Pattern Tracer 40
Special Molding Machines 40
Among the Foundries 41
Chicago Sand Rammer 45